

**Operating Manual
Axioskop 40 / Axioskop 40 FL
Routine microscope**

Knowledge of this manual is required for the operation of the instrument. Would you therefore please make yourself familiar with the contents of this manual and pay special attention to hints concerning safe operation of the instrument.

The specifications are subject to change; the manual is not covered by an update service.

© Unless expressly authorized, forwarding and duplication of this document and the software package, as well as utilization and communication of its contents are not permitted. Violations will entail an obligation to pay compensation.

All rights reserved in the event of granting of patents or registration of a utility model.

Issued by:

Carl Zeiss
Light Microscopy

P.O.B. 4041
D-37030 Goettingen
GERMANY
Phone: ++49 551 5060 660
Telefax: ++49 551 5060 464
Internet: www.zeiss.de/micro
E-Mail: micro@zeiss.de

Number of this manual: B 40-810 e

Date of issue: 12/01/2001

CONTENTS

	Page
INTRODUCTION	0-2
Copyright	0-2
Contents	0-3
Microscopy in a few steps	0-7
Notes on instrument safety	0-8
Notes on warranty	0-11
Overall view of Axioskop 40	0-12
Overall view of Axioskop 40 FL	0-13
CHAPTER 1 INSTRUMENT DESCRIPTION	1-2
1.1 Name and intended application	1-2
1.2 Instrument description and main features	1-2
1.3 System Overview Axioskop 40 / 40 FL	1-4
1.4 Objectives	1-8
1.5 Eyepieces	1-10
1.6 Stage micrometers and eyepiece reticles	1-11
1.7 Technical data	1-13

CHAPTER 2 START-UP	2-4
2.1 Initial start-up	2-4
2.1.1 Unpacking and installing the microscope	2-4
2.1.2 Attaching binocular tube or phototube	2-5
2.1.3 Inserting eyepieces and auxiliary microscope	2-5
2.1.4 Setting interpupillary distance of the binocular tube	2-7
2.1.5 Setting the viewing height	2-7
2.1.6 Mounting objectives	2-8
2.1.7 Inserting the refill set in the specimen marker	2-9
2.1.8 Attaching the universal condenser	2-10
2.1.9 Connecting to power	2-11
2.1.10 Switching the microscope and HBO 100 W transformer on and off	2-11
2.1.11 Inserting and replacing the 12 V, 35 W halogen lamp	2-12
2.1.12 HBO 103 illuminator (Axioskop 40 FL)	2-13
2.1.13 HBO 50 fluorescence illuminator (Axioskop 40 FL)	2-17
2.2 Attachments and conversions	2-19
2.2.1 Changing the condenser	2-19
2.2.2 Inserting stops (Ph, Var) and neutral filter in slider	2-20
2.2.3 Attaching filter mount	2-21
2.2.4 Attaching polarizer D	2-21
2.2.5 Attaching overview adapter	2-22
2.2.6 Changing the HBO 103 W/2 mercury vapor short-arc lamp	2-23
2.2.7 Changing the burner for the HBO 50 fluorescence illuminator	2-26
2.2.8 Mechanical stage with torque setting	2-28
2.2.9 Changing the mechanical stage	2-29
2.2.10 Changing the binocular tube	2-33
2.2.11 Attaching Axioskop connector plate	2-34
2.2.12 Installing and removing "Push&Click" modules on the Axioskop 40 FL	2-35
2.2.13 Changing the filter set in the FL P&C reflector module	2-36
2.2.14 Changing the beam splitter in the FL P&C reflector module	2-38
2.2.15 Attaching the active co-observation equipment for 2 users	2-40
2.2.16 Attaching the multi-observation equipment	2-42
2.2.17 Attaching the intermediate tube for image projection	2-44

	Page
CHAPTER 3 OPERATION	3-4
3.1	Axioskop 40 operation and function controls.....
3.2	Axioskop 40 FL operation and function controls
3.3	Operation controls for accessory components.....
3.4	Switching Axioskop 40 and Axioskop 40 FL on and off
3.5	Illumination and contrast procedures.....
3.5.1	Setting transmitted-light bright field according to KÖHLER.....
3.5.2	Setting transmitted-light phase contrast
3.5.3	Setting transmitted-light VAREL contrast
3.5.4	Setting transmitted-light dark field
3.5.5	Setting transmitted-light oblique illumination
3.5.6	Setting transmitted-light polarization.....
3.5.7	Setting epi-fluorescence.....
3.6	Documentation.....
3.6.1	Attaching photomicrography equipment.....
3.6.2	Attaching adapters for video cameras.....
3.6.3	Attaching adapters for compact digital cameras
3.6.4	Digital cameras with 37 mm filter thread, e.g. SONY DCR-PC100 / SONY DSC-S50
3.6.5	Digital cameras with 52 mm filter thread, e.g. SONY DSC-S70, DSC-S75, DSC-S85
3.6.6	Adapting cameras with different filter thread sizes
3.6.7	Sony DSC-S70, DC-S75, DSC-S85 on digital camera adapter 44 M52x0.75
3.7	Multiple observer equipment.....
3.7.1	Using active co-observation equipment for 2 users
3.7.2	Using multi-observation equipment.....
3.8	Drawing device.....
3.8.1	Attaching switchable intermediate tube for image projection.....
3.9	Measuring lengths

CHAPTER 4	CARE, MAINTENANCE, TROUBLESHOOTING AND SERVICE	4-2
4.1	Instrument care	4-2
4.2	Instrument maintenance	4-3
4.2.1	Performing checks	4-3
4.2.2	Changing fuses	4-3
4.3	Troubleshooting	4-4
4.4	Spares, consumables and tools	4-8
4.5	Requesting service	4-9

APPENDIX

List of abbreviations.....	A-2
Index.....	A-4
Certification in accordance with DIN ISO 9001 / EN 46001	
EC conformity declaration	

Microscopy in a few steps using the example of "Setting of transmitted-light brightfield according to KÖHLER"

 Please read the instructions regarding instrument safety and the Instrument Description (Chapter 1) and Start-Up (Chapter 2) chapters before using the Axioskop 40 or Axioskop 40 FL microscopes for the first time.

- (1) As described in Chapter 2 (Start-Up), the microscope is ready for operation and switched on according to Section 3.4.
- (2) Place a high-contrast specimen on the mechanical stage (cover slip pointing up).
- (3) Swivel in 10x objective on the nosepiece and focus on the specimen; where possible, always move the specimen away from the objective!
- (4) Move the condenser - e.g. condenser 0.9/1.25 H - to the upper stop position via the condenser drive. The height adjustment must be preset in such a manner that the specimen is not moved by the condenser. If the 0.9/1.25 H condenser is equipped with the slider for PH/H/Var, place it in the middle position for bright field.
- (5) Close the luminous-field diaphragm until it is visible in the field of view, even if not in focus (Fig. 0-1/A).
- (6) Lower condenser 0.9/1.25 H until the edge of the luminous-field diaphragm appears in focus (Fig. 0-1/B).
- (7) Center the luminous-field diaphragm using centering screws on the condenser carrier (Fig. 0-1/C) and open it until its edge just disappears behind the field of view (Fig. 0-1/D).
- (8) To set the aperture diaphragm (contrast), remove one eyepiece from the binocular tube and set the aperture diaphragm to approx. 2/3 of the diameter of the objective exit pupil (Fig. 0-1/E). Optimum contrast setting is dependent on the specimen used.
- (9) Insert the eyepiece again and, where necessary, refocus on the specimen via the fine drive.
- (10) After each objective change, the field size and objective aperture change, which makes it necessary to repeat steps (5) to (9).

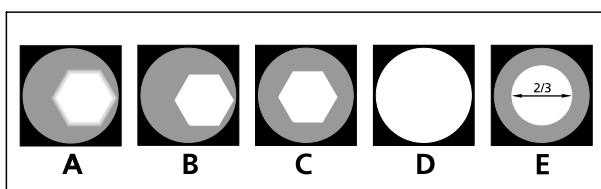


Fig. 0-1 Diaphragm setting in transmitted-light bright field according to KÖHLER

Notes on instrument safety

The Axioskop 40 and Axioskop 40 FL microscopes have been designed, produced and tested in compliance with DIN 61010-1 (IEC 1010-1) safety requirements for electrical measuring, control and laboratory instruments, and meet the requirements of Appendix I of directive 73/23/EC.

The instruments meet the requirements of EC directive 89/336/EC and EMC legislation dated September 18, 1998. This operating manual includes information and warnings that must be observed by the user.

The following warning and information symbols are used in this manual:



NOTE

This symbol is a warning which you must observe under all circumstances.



CAUTION

This symbol is a warning which indicates a hazard to the instrument or instrument system.



CAUTION

This symbol is a warning which indicates a hazard to the user of the instrument.



CAUTION

Hot surface!



CAUTION

UV radiation is emitted!



CAUTION

Disconnect the instrument from the line before opening it!

The Axioskop 40 and Axioskop 40 FL microscopes, including original accessories, may only be used for the microscope techniques described in this manual.

Particular attention must be paid to the following warnings:



The manufacturer cannot assume any liability for any other applications, including individual modules or single parts. This also applies to all service or repair work that is not carried out by authorized service personnel. All warranty claims shall be forfeited.



The power plug must be inserted in an outlet featuring a grounding (earth) contact. The grounding effect must not be made ineffective by an extension cable that does not have a protective ground wire.



If it is determined that protection measures are no longer effective, the instrument must be switched off and safeguarded against inadvertent operation. Please contact a Zeiss service agency or the Carl Zeiss Microscopy Service to repair the instrument.



The power supply integrated in the stands of the microscopes enables line voltages to be used in the range between 100 and 240 V $\pm 10\%$, 50 / 60 Hz, without the voltage on the instrument having to be changed.

The transformers for the HBO 103 (ebq 100 dc) or XBO 75 (ebx 75 isolated) are designed for the 100 to 240 V AC, 50 to 60 Hz range. They adapt automatically to the available line voltage. There is no need to change the voltage.

However, the transformer for the HBO 50 must be set manually to the correct voltage (100, 110, 120, 127 or 230, 240 V), and the correct frequency must be preselected (50 or 60 Hz).



Before switching on the instrument, check as to whether it is suitable for the given line voltage. Always disconnect the instrument from the power outlet before opening the instrument and before changing the fuses.



Take sure to ensure you only use fuses of the rated power required. Use of makeshift fuses and short-circuiting of the fuse holders are not permitted.





The Axioskop 40 and Axioskop 40 FL microscopes are not equipped with any special devices for protection from substances that are corrosive, toxic, radioactive or other substances that could be hazardous to health. All the legal regulations, particularly the pertinent accident prevention regulations of the respective country, must be observed when handling such substances.



Gas-discharge lamps, e.g. HBO 50 or HBO 103, emit ultraviolet radiation, which can cause burns to the eyes and skin. Therefore, never look directly into the light of these lamps and avoid direct, unprotected incidence of their light on your skin. When using the microscope, always use the protective devices belonging to the instrument (e.g. special attenuation filters or the fluorescence protection shield). When they are hot, gas-discharge lamps are under high internal pressure and may therefore only be changed when they have cooled down, and protective gloves and goggles must be used (for detailed information please see Operating Manual B 40-065 e).



When fluorescence filters are used, the heat protection filter for heat emitted by the microscope illuminator must not be removed, since fluorescence filters are sensitive to heat, and their performance could be impaired.



Avoid touching the hot lamp housing. Always pull the power plug before changing the lamps and allow the instrument to cool down for some 15 minutes.



Dust and dirt may impair the instrument's performance. Therefore, the instrument must be protected from these influences as far as possible and covered with the dust cover when not in use. Always check whether the instrument is switched off before you cover it.



Placing objects against or covering ventilation slats may lead to heat build-up that will damage the instrument and, in extreme cases, cause a fire. Always keep the ventilation slats clear and ensure that no objects enter the instrument through the ventilation slats.



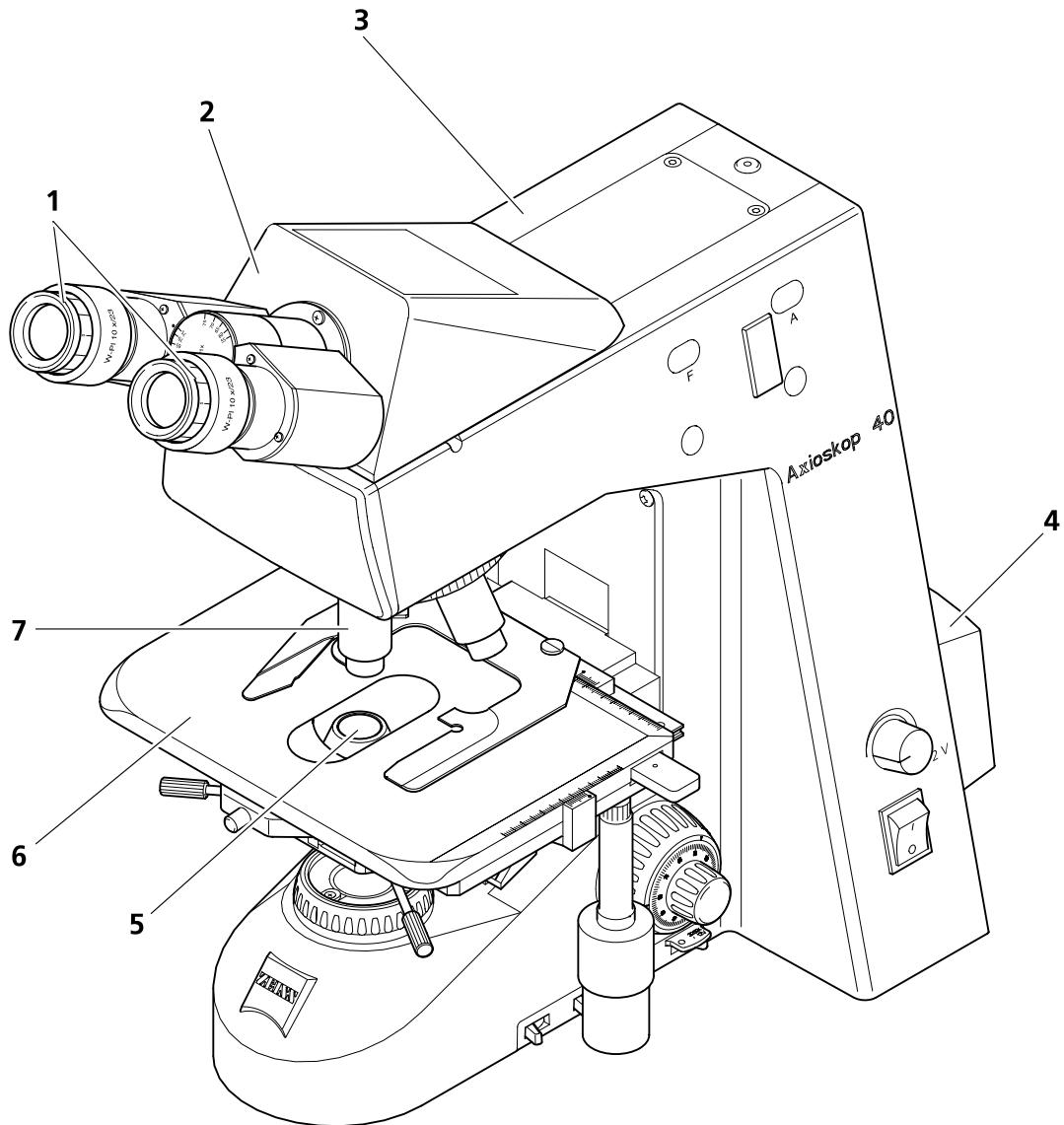
The instruments may only be operated by trained personnel who must be aware of the possible dangers involved with microscopy and the particular application concerned. The Axioskop 40 / Axioskop 40 FL is a high-precision instrument that can be impaired in its performance or destroyed when handled improperly.

Notes on warranty

The manufacturer guarantees that the instrument has no material or production defects when delivered. You must inform us of any defects immediately and do everything to minimize any damage. If the manufacturer is informed of such a defect, he is obligated to rectify it; it is his decision whether he does this by repairing the instrument or by delivering an instrument free of any defect. No guarantee is provided for defects caused by natural wear (wearing parts and consumables in particular) and improper use.

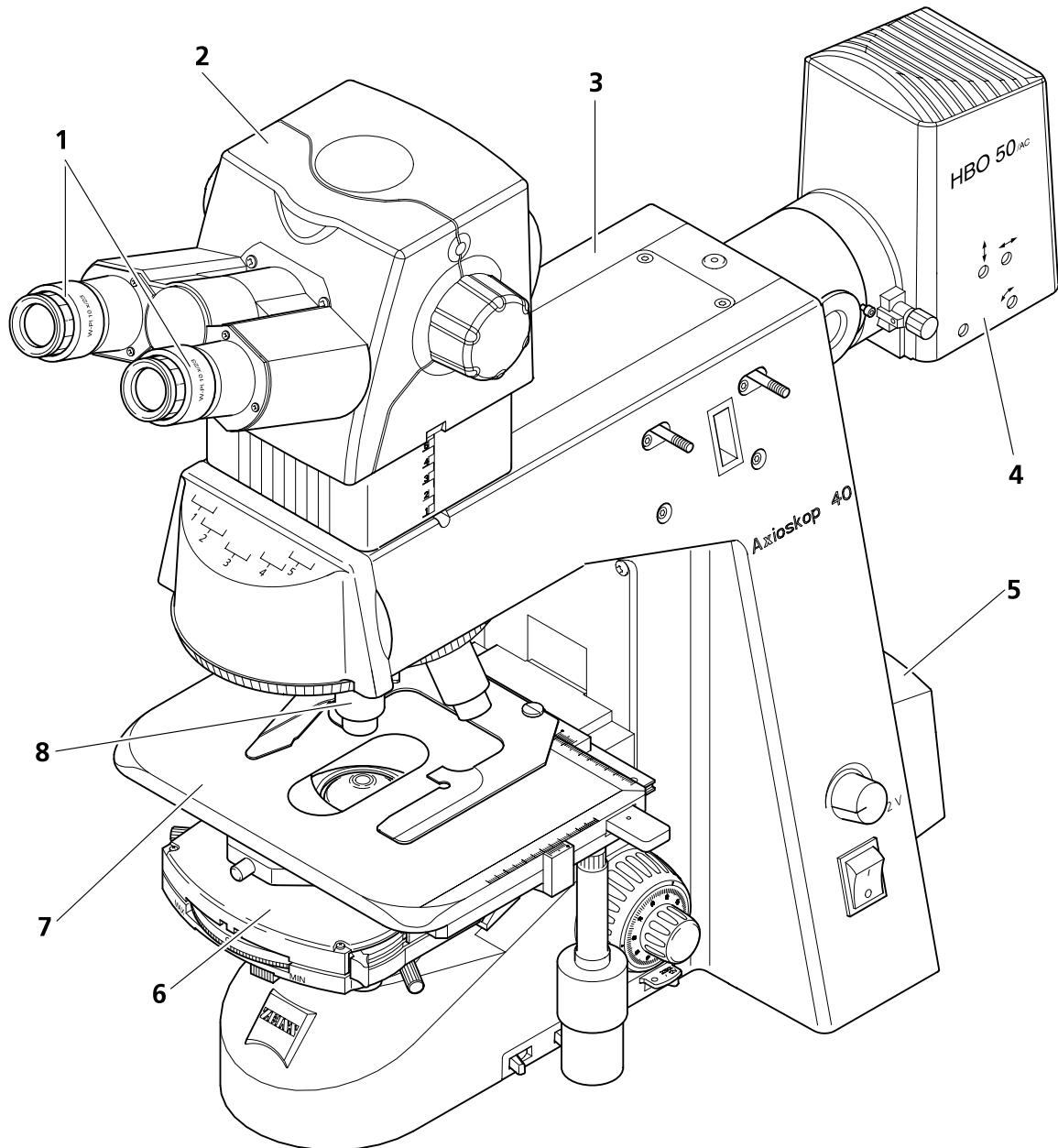
The instrument manufacturer is not liable for damage caused by faulty operation, negligence or any other tampering with the instrument, particularly the removal or replacement of instrument components, or the use of accessories from other manufacturers. This forfeits all warranty claims.

With the exception of the work specified in this manual, no maintenance or repair of the Axioskop 40 / Axioskop 40 FL may be undertaken. Repairs may only be performed by Zeiss service staff or specially authorized personnel. Should any defect occur with the instrument, please get in touch with your local Zeiss representative.

Overall view of Axioskop 40

- 1 Eyepieces
- 2 Binocular tube
- 3 Stand
- 4 Transmitted-light illuminator
- 5 Condenser 0.9/1.25 H
- 6 Mechanical stage
- 7 Objective

Overall view of Axioskop 40 FL



- 1 Eyepieces
- 2 Ergo-tube 20°/23 with height adjustment
- 3 Stand
- 4 Incident-light illuminator
- 5 Transmitted-light illuminator
- 6 Universal condenser 0.9
- 7 Mechanical stage
- 8 Objective

Carl Zeiss

INTRODUCTION

Axioskop 40
Axioskop 40 FL

INSTRUMENT DESCRIPTION

Table of contents

1	INSTRUMENT DESCRIPTION.....	1-2
1.1	Name and intended application	1-2
1.2	Instrument description and main features	1-2
1.3	System Overview Axioskop 40 / 40 FL	1-4
1.4	Objectives	1-8
1.5	Eyepieces	1-10
1.6	Stage micrometers and eyepiece reticules	1-11
1.7	Technical data	1-13

List of illustrations

Fig. 1-1	Objective.....	1-8
----------	----------------	-----

1 INSTRUMENT DESCRIPTION

1.1 Name and intended application

Manufacturer's designation: Axioskop 40 microscope
Axioskop 40 FL microscope

The Axioskop 40 and Axioskop 40 FL microscopes have been designed as universal microscopes for biomedical applications. They can be used as pure transmitted-light microscopes or, with epi-fluorescence equipment, as combined transmitted-light / reflected-light microscopes

The Axioskop 40 and Axioskop 40 FL microscopes are mainly used in:

- hospitals
- doctor's offices
- universities and in
- industry

1.2 Instrument description and main features

With the advanced pyramid and modular design, the Axioskop 40/40 FL incorporates time-tested principles in microscope construction, thus ideally combining modern requirements made on design, ergonomics, operating convenience and function with technical performance. Due to the modular design, existing microscope modules from the Axioskop 2 plus and Axioplan 2 imaging, such as tubes, intermediate tubes and condensers, are easy to attach. A connector plate must be mounted for Axioplan 2 imaging modules.

Depending on the instrument configuration, the following microscopy and contrasting techniques are possible:

Transmitted light:

- bright field
- dark field
- phase contrast
- VAREL contrast
- polarization contrast

Reflected light:

- fluorescence contrast

The Axioskop 40 FL stand includes epi-fluorescence equipment. The optional adjustment guide is integrated into the microscope stand in the factory when ordered. For technical reasons, retrofitting existing transmitted-light instruments with the epi-fluorescence equipment should be performed by Zeiss service staff, since the nosepiece must also be retrofitted.

The binocular phototubes and suitable adapters enable one microscope camera, one reflex camera or one digital / video camera to be attached for documentation purposes.

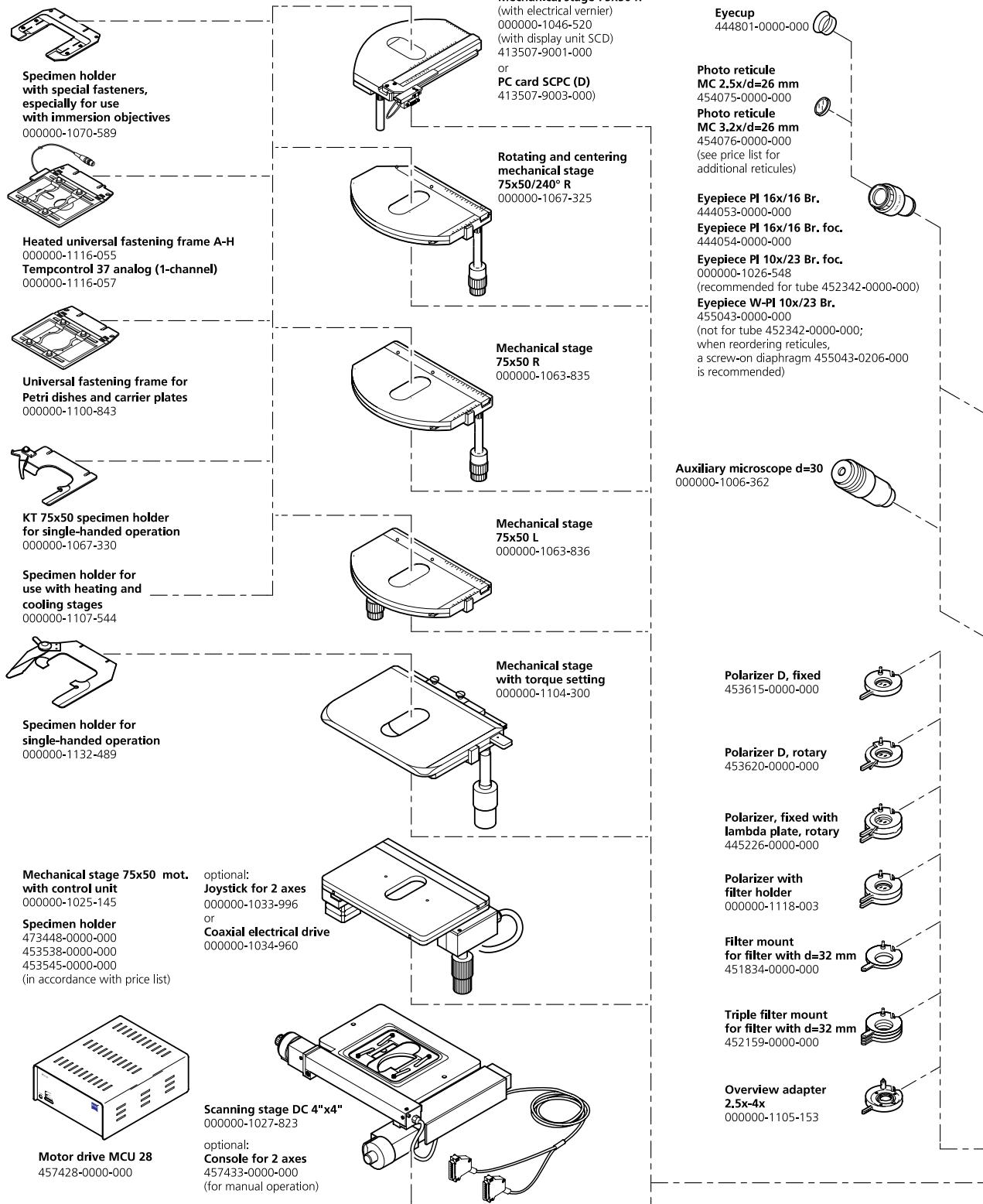
Major instrument features of the **Axioskop 40**:

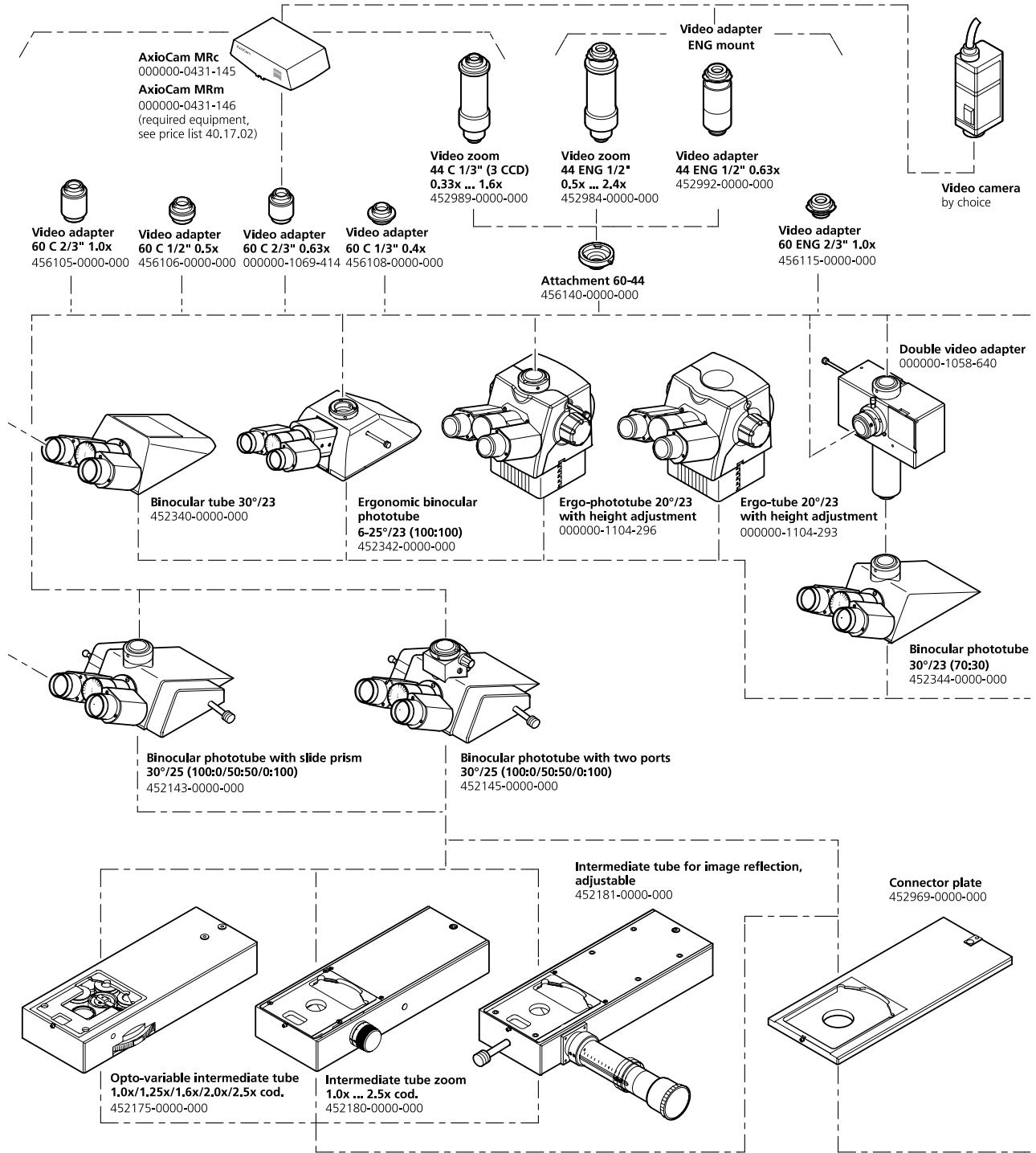
- Stable and sturdy diecast stand with T-shaped base in pyramid design and integrated power supply for the 12 V, 35 W halogen lamp
- Stage focusing via coaxial rough / fine drive
- Fixed and rotary mechanical stage with ceramic-coated surface and variable drive length
- Installed 12 V, 35 W lamp for transmitted light and HBO 50 or HBO 103 for reflected light
- Condenser 0.9/1.25 H for bright-field applications as well as for phase and variable contrast when used in combination with a separate slider for Ph / Var
- Ball-bearing, 6-position nosepiece with W 0.8" thread
- ICS objectives in the cost-performance categories A-Plan, Achromplan, Plan-Neofluar, Plan-APOCHROMAT
- Binocular tubes and phototubes with fixed and variable viewing angle as well as ergo-tubes and ergo-phototubes with infinitely variable height adjustment
- Adjustable 10x focusing eyepieces with field-of-view number 23, suitable for eyeglass wearers
- Wide variety of attachment possibilities for photography and video-microscopy
- Multi-observation equipment for 2 or 9 viewing stations

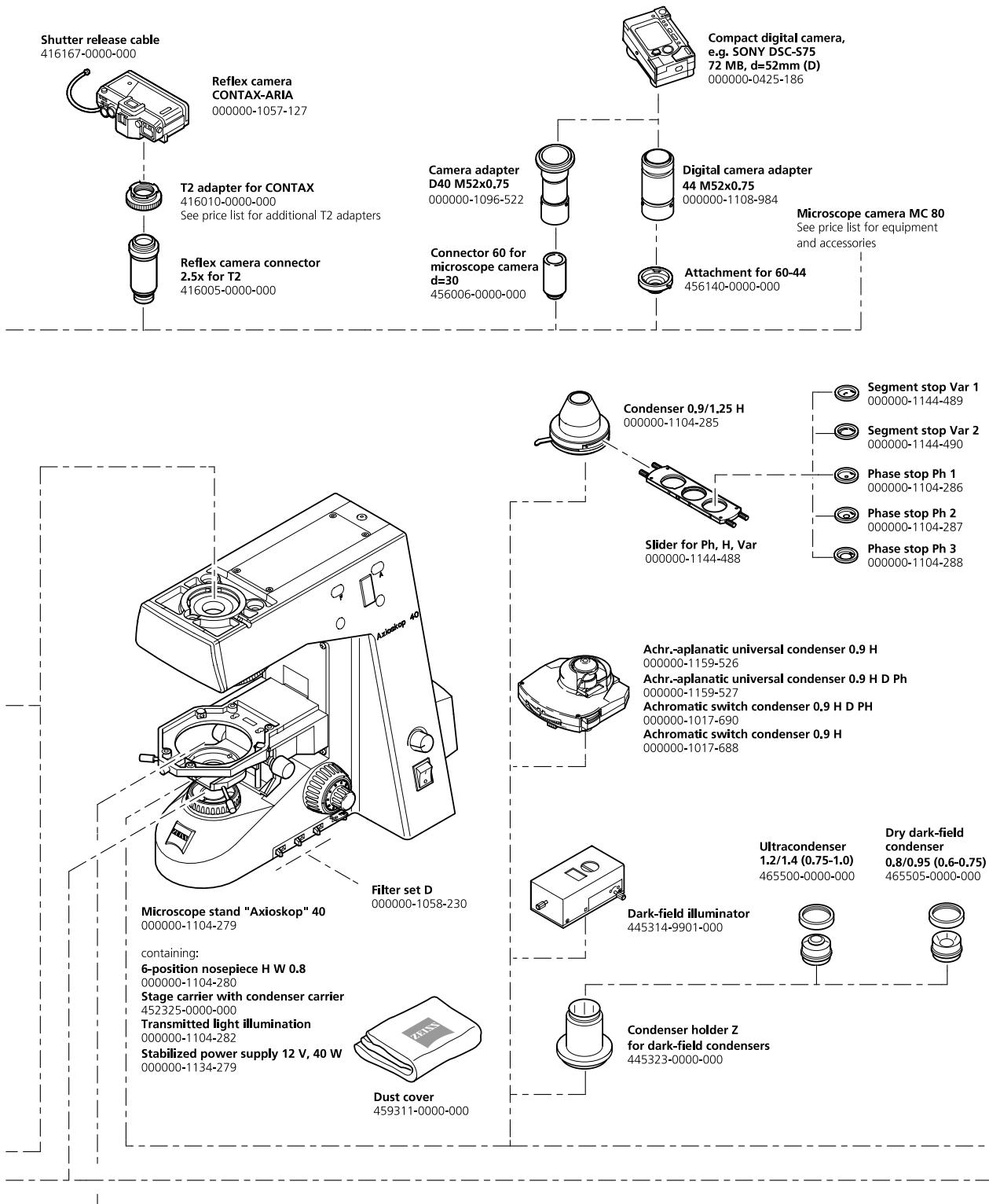
Additional features of the **Axioskop 40 FL**:

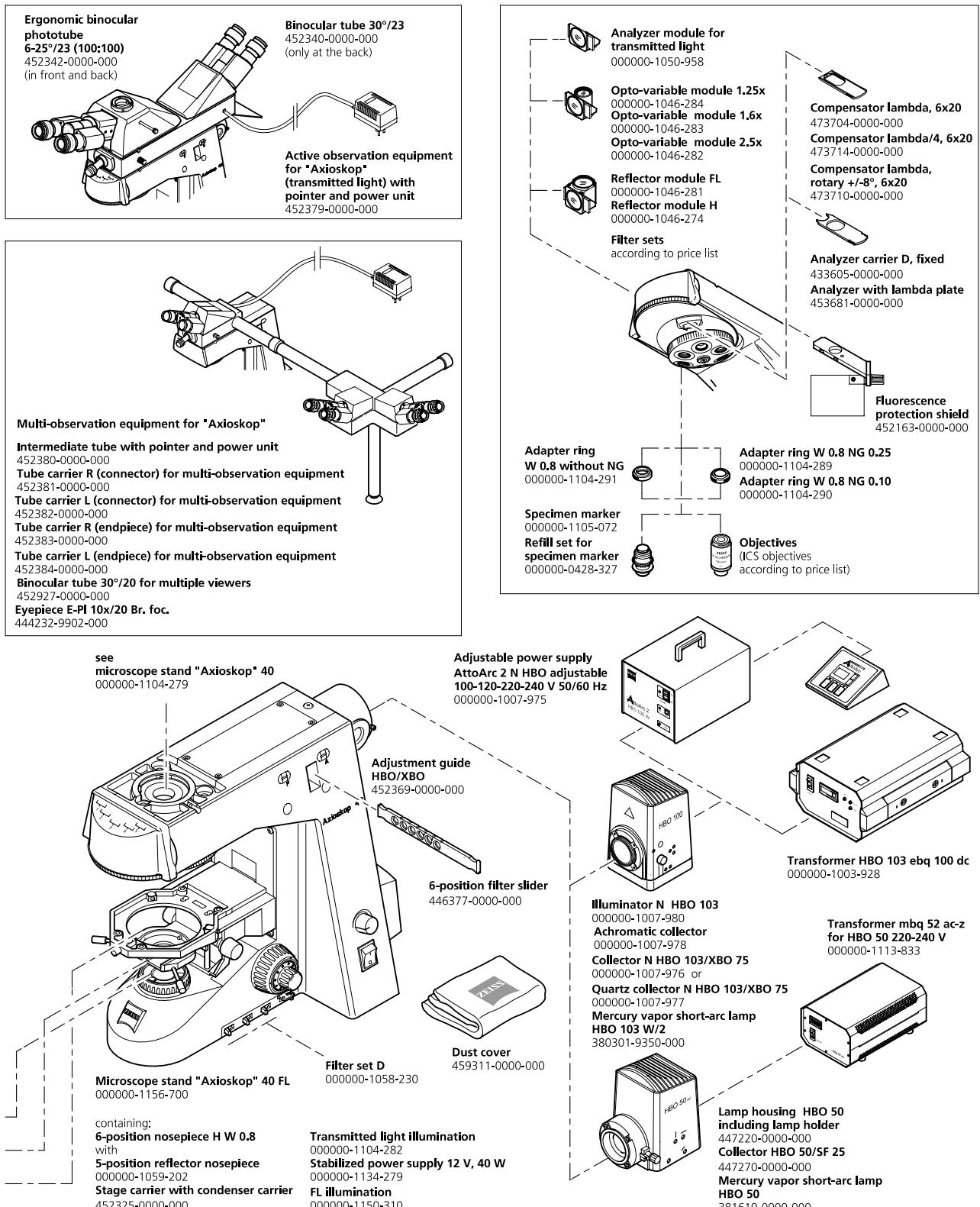
- High-performance epi-fluorescence equipment
- 6-position nosepiece with W 0.8" thread and 5-position reflector turret

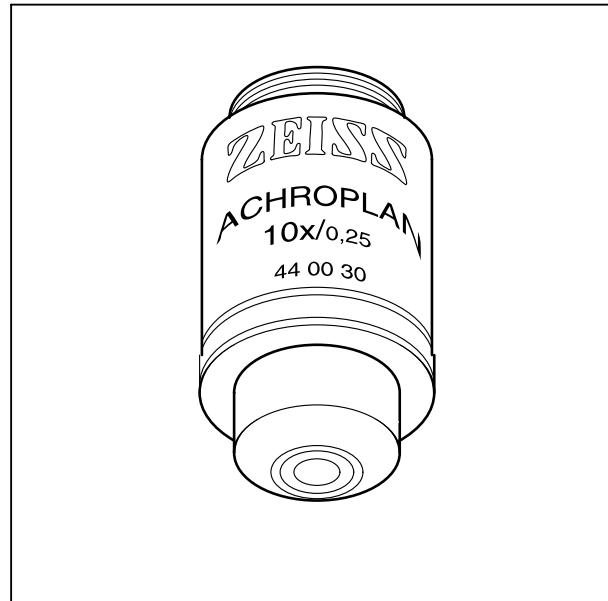
1.3 System Overview Axioskop 40 / 40 FL









**Fig. 1-1 Objective**

1.4 Objectives

The objectives are the optical heart of the microscope. The following is an example of how objectives can be labelled:

Achroplan 10x/0.25 ∞ /0.17

where

10x : objective magnification, with a defined color ring on the objective being allocated to each magnification step (Zeiss color code)

0.25 : numerical aperture

∞ : infinite image distance; these objectives can only be used with ICS microscopes from Carl Zeiss

0.17 : can only be used with cover slip thickness $D = 0.17$ mm

or

– : can be used with cover slip thickness $D = 0$ or 0.17 mm

Other labels:

Oil : oil immersion objective

Ph 2 : phase contrast objective with a green color ring and phase stop Ph 2

Color ring code for objective magnification:

Color ring on objective	black	brown	red	orange	yellow	green	light blue	dark blue	white
Magnification factor	1.25x	2.5x	4x; 5x	6.3x	10x	16x;20x; 25x;32x	40x; 50x	63x	100x; 150x

Objective magnification multiplied by eyepiece magnification (usually 10x) results in overall visual magnification: e.g. $10 \times 10 = 100x$.

When working with the microscopes, total magnification should not drop below or exceed the range of useful magnification. The range of useful magnification was defined by Ernst ABBE as 500 to 1,000 times the numerical aperture of the objective used. There is no resolution for further details above that limit. Accordingly, the range of useful magnification for an objective with a numerical aperture of 0.25 is between 125x and 250x.

Exact observance of the cover slip thickness of 0.17 mm is all the more necessary the higher the numerical aperture of the objective. For this reason, certain objectives can be set to different cover slip thicknesses (due to correction mount). To this end, a specimen area is searched for, and the position of the correction ring where optimum focus and image contrast are obtained is determined (refocusing is invariably required).

When immersion objectives are used, the air between the cover slip and the objective is replaced by a liquid, which in most cases is immersion oil. The plastic oiler containing 20 ml of 581 N immersion oil ($n_D = 1.515$) is particularly suitable for this purpose.

To prevent oil contamination of the specimen when the nosepiece is turned, the resilient mounts of the immersion objectives can be locked in their lifted position by turning them clockwise (do not forget to unlock them again!).

The following objectives are ideal for the Axioskop 40 and Axioskop 40 FL microscopes:

Microscopy technique	Objective	Magnification / Num. Aperture	Free working distance in mm	Cover slip thickness D in mm	Cat. No
Transmitted-light bright field	A-Plan				
	A-Plan	2.5x/0.06	9.4	-	000000-1113-114
	A-Plan	5x/0.12	9.9	-	441020-0000-000
	A-Plan	10x/0.25	4.4	-	441030-0000-000
	A-Plan	20x/0.45	0.53	0.17	441040-0000-000
	A-Plan	40x/0.65	0.43	0.17	441050-0000-000
Phase contrast	A-Plan	100x/1.25 Oil	0.22	0.17	441080-0000-000
	A-Plan	10x/0.25 Ph 1	4.4	-	441031-0000-000
	A-Plan	20x/0.45 Ph 2	0.53	0.17	441041-0000-000
	A-Plan	40x/0.65 Ph 2	0.43	0.17	441051-0000-000
VAREL contrast	A-Plan	100x/1.25 Oil Ph 3	0.22	0.17	441081-0000-000
	A-Plan	10x/0.25 Ph 1 Var 1	4.4	-	000000-1020-863
	A-Plan	40x/0.65 Ph 2 Var 2	0.43	0.17	000000-1115-207
Transmitted-light bright field	Achroplan				
	Achroplan	4x/0.10	11.1	-	440020-0000-000
	Achroplan	10x/0.25	4.8	-	440030-0000-000
	Achroplan	20x/0.45	2.07	0.17	440040-0000-000
	Achroplan	40x/0.65	0.59	0.17	440050-0000-000
	Achroplan	50x/0.90 Oil	0.29	0.17	440057-0000-000
	Achroplan	63x/0.80	0.29	0.17	440060-0000-000
	Achroplan	63x/0.95	0.15	0 (no cover slip)	440068-0000-000
	Achroplan	100x/1.25 Oil	0.19	0.17	440080-0000-000
	Achroplan	100x/1.25 Oil Iris	0.19	0.17	440086-0000-000
Phase contrast	Achroplan	10x/0.25 Ph 1	4.8	-	440031-0000-000
	Achroplan	20x/0.45 Ph 2	2.07	0.17	440041-0000-000
	Achroplan	40x/0.65 Ph 2	0.59	0.17	440051-0000-000
	Achroplan	100x/1.25 Oil Ph 3	0.19	0.17	440081-0000-000
Transmitted-light bright field	Plan-Neofluar				
	Plan-Neofluar	2.5x/0.075	9.3	-	440310-0000-000
	Plan-Neofluar	5x/0.15	13.6	-	440320-0000-000
	Plan-Neofluar	10x/0.30	5.6	0.17	440330-0000-000
	Plan-Neofluar	20x/0.50	1.3	0.17	000000-1004-072
	Plan-Neofluar	40x/0.75	0.47	0.17	440350-9902-000
	Plan-Neofluar	100x/1.30 Oil	0.06	0.17	000000-1018-595

Microscopy technique	Objective	Magnification / Num. Aperture	Free working distance in mm	Cover slip thickness D in mm	Cat. No
Phase contrast	Plan-Neofluar	10x/0.30 Ph 1	5.6	0.17	440331-0000-000
	Plan-Neofluar	20x/0.50 Ph 2	1.3	0.17	000000-1004-989
	Plan-Neofluar	40x/0.75 Ph 2	0.47	0.17	440351-9902-000
	Plan-Neofluar	100x/1.30 Oil Ph 3	0.06	0.17	000000-1031-171
Transmitted-light bright field	Plan-APOCHROMAT	40x/1.00 Oil Iris	0.31	0.17	440756-0000-000
	Plan-APOCHROMAT	63x/1.40 Oil	0.09	0.17	440760-0000-000
	Plan-APOCHROMAT	100x/1.40 Oil	0.09	0.17	440780-0000-000

1.5 Eyepieces

The following eyepieces are offered for the Axioskop 40 and Axioskop 40 FL:

Eyepiece	Image angle	Application	Cat. No.
Eyepiece W-PL 10x/23 Br. foc. (2x)	49.4°	with all tubes, see Pp. 1-4 ff.; recommended for ergo-tubes (000000-1104-293 / 296)	455043-0000-000, aspheric
Eyepiece PL 10x/23 Br. foc. (2x)	49.4°	with all tubes, see Pp. 1-4 ff.; recommended for ergonomic binocular phototube (452342-0000-000)	000000-1026-548
Eyepiece PL 16x/16 Br.	54°	with all tubes, see Pp. 1-4 ff.	444053-0000-000
Eyepiece PL 16x/16 Br. foc.	54°	with all tubes, see Pp. 1-4 ff.	444054-0000-000

W-PL and PL in the eyepiece designation refers to the excellent image flatness up to the edge of the field of view. If required, eyecups for the eyepieces can be ordered under Cat. No. 444801-0000-000.

1.6 Stage micrometers and eyepiece reticles

Measuring and counting using a microscope requires stage micrometers and eyepiece reticles, a selection of which is listed below:

Illustration	Designation, technical data	Cat. No.
	Stage micrometer, positive 5 + 100/100 y D = 0.17 mm gradation on the +y-axis: 5 mm in 5 intervals gradation on the -y-axis: 1 mm in 100 intervals with 2 opposing scales = 10 µm, accuracy ±1µm	474026-0000-000
	Crossline micrometer 14:140, d = 26 mm gradation length = 14 mm increments = 0.1mm gradation tolerance ≤ 0.001 mm	454060-0000-000
	Eyepiece reticule / d = 26 mm	474064-0000-000
	Crossline micrometer 10:100, d = 26 mm gradation length = 10 mm increments = 0.1mm gradation tolerance ≤ 0.001 mm	474066-9901-000

Illustration	Designation, technical data	Cat. No.
	Net micrometer 12.5x12.5/5;10 / d = 26 mm area 12.5x12.5 mm, divided into 10x10 fields	474068-0000-000
	Photo reticule MC 2.5x / d = 26 mm for 35 mm photography with 2.5x additional magnification or for large-format photography with 10x additional magnification.	454075-0000-000

 If an eyepiece reticule is used, the binocular tube or the phototube must be equipped with two eyepieces with an adjustable lens, into one of which the eyepiece reticule is mounted.

1.7 Technical data

Dimensions (width x depth x height)

Axioskop 40 stand approx. 280 mm x 560 mm x 505 mm
Axioskop 40 FL stand with HBO 100
and adjustable ergo-tube 20°/23 in highest setting approx. 280 mm x 730 mm x 555 mm

Weight

Axioskop 40 approx. 15 kg
Axioskop 40 FL with HBO 100 approx. 19.5 kg

Ambient conditions

Storage and transport (in packaging)

Permissible ambient temperature -10 to + 50 °C
Permissible relative humidity 20 % to 75 % at +35 °C
Atmospheric pressure 800 hPa to 1060 hPa

Operation

Permissible ambient temperature +10 to + 35 °C
Permissible relative humidity 20 % to 75 % at +35 °C
Atmospheric pressure 800 hPa to 1060 hPa
Altitude max. 2000 m
Pollution degree 2

Operating data

Operating environment clean room
Protection class I
Protection type IP 20
Electrical safety in compliance with DIN EN 61010-1 (IEC 1010-1)
including CSA and UL directives
Overvoltage category II
Radio interference suppression in accordance with EN 55011, Class B
Insensitivity to interference in accordance with EN 50082-2
Line voltage 100 to 240 V ±10 %
Change of voltage is not required!
Line frequency 50 to 60 Hz
Power consumption of Axioskop 40 / Axioskop 40 FL 100 VA

HBO 50 transformer mbq52ac-z

Operating environment	clean room
Protection class	I
Protection type.....	IP 20
Line voltage can be changed between	100, 110, 120, 127 VAC and 230, 240 VAC
Line frequency can be changed between	50 and 60 Hz
Power consumption when HBO 50 is used	max. 350 VA

HBO 100 W (HBO 100 W/2 and HBO 103 W/2) transformer

Operating environment	clean room
Protection class	I
Protection type.....	IP 20
Line voltage	100 VAC ... 240 VAC
Line frequency	50 ... 60 Hz
Power consumption when HBO 103 is used	260 VA

Fuses in accordance with IEC 127

Axioskop 40 microscope stand	T 1 A/H, 5x20 mm
Axioskop 40 FL microscope stand	T 1 A/H, 5x20 mm
HBO 50AC transformer mbq52ac-z	100 V, 127 V: 2x T 4 A 220 V – 240 V: 2x T 2.5 A
HBO 100 W transformer.....	T 3.15 A/H, 5x20 mm

Light sources

Halogen lamp	12 V / 35 W
Adjustment of the light source	continuous, 3 to 12 V
Mercury vapor short-arc lamp.....	HBO 50
Power consumption for HBO 50	50 W
Mercury vapor short-arc lamp.....	HBO 103 W/2
Power consumption for HBO 103 W/2	100 W

Axioskop 40 / Axioskop 40 FL

Stand with manual stage focusing

rough drive approx. 5 mm / rotation
fine drive approx. 0.5 mm / rotation; approx. 5 μm increments
lifting range approx. 24 mm
height stop can be set mechanically

Achromatic-aplanatic universal condenser 0.9 with

swivel front lens 0.9;
for objective magnifications $V_{\text{Obj.}} < 10$ swivel out front lens 0.9
for objective magnifications $V_{\text{Obj.}} \geq 10x$ swivel in front lens 0.9
bright-field insert or turret disk with positions for brightfield, darkfield
for phase contrast 1, 2, 3

Objective change manually via 6-position nosepiece H, W 0.8"
Change of reflector module (only with Axioskop 40 FL) manually via 5-position reflector turret

Carl Zeiss

INSTRUMENT DESCRIPTION

Axioskop 40
Axioskop 40 FL

START-UP

Table of contents

2	START-UP	2-4
2.1	Initial start-up.....	2-4
2.1.1	Unpacking and installing the microscope	2-4
2.1.2	Attaching binocular tube or phototube	2-5
2.1.3	Inserting eyepieces and auxiliary microscope	2-5
2.1.4	Setting interpupillary distance of the binocular tube	2-7
2.1.5	Setting the viewing height.....	2-7
2.1.6	Mounting objectives	2-8
2.1.7	Inserting the refill set in the specimen marker	2-9
2.1.8	Attaching the universal condenser	2-10
2.1.9	Connecting to power	2-11
2.1.10	Switching the microscope and HBO 100 W transformer on and off	2-11
2.1.11	Inserting and replacing the 12 V, 35 W halogen lamp	2-12
2.1.12	HBO 103 illuminator (Axioskop 40 FL)	2-13
2.1.13	HBO 50 fluorescence illuminator (Axioskop 40 FL)	2-17
2.2	Attachments and conversions	2-19
2.2.1	Changing the condenser	2-19
2.2.2	Inserting stops (Ph, Var) and neutral filter in slider	2-20
2.2.3	Attaching filter mount	2-21
2.2.4	Attaching polarizer D.....	2-21
2.2.5	Attaching overview adapter.....	2-22
2.2.6	Changing the HBO 103 W/2 mercury vapor short-arc lamp	2-23
2.2.7	Changing the burner for the HBO 50 fluorescence illuminator.....	2-26
2.2.8	Mechanical stage with torque setting	2-28
2.2.9	Changing the mechanical stage	2-29
2.2.10	Changing the binocular tube	2-33
2.2.11	Attaching Axioskop connector plate.....	2-34
2.2.12	Installing and removing "Push&Click" modules on the Axioskop 40 FL	2-35
2.2.13	Changing the filter set in the FL P&C reflector module	2-36
2.2.14	Changing the beam splitter in the FL P&C reflector module	2-38
2.2.15	Attaching the active co-observation equipment for 2 users.....	2-40
2.2.16	Attaching the multi-observation equipment	2-42
2.2.17	Attaching the intermediate tube for image projection	2-44

List of illustrations

Fig. 2-1	Setting up the microscope.....	2-4
Fig. 2-2	Attaching the binocular tube.....	2-5
Fig. 2-3	Inserting eyepieces.....	2-5
Fig. 2-4	Inserting the eyepiece reticule	2-6
Fig. 2-5	Setting the interpupillary distance of the binocular tube.....	2-7
Fig. 2-6	Setting the viewing height of the binocular tube.....	2-7
Fig. 2-7	Mounting objectives.....	2-8
Fig. 2-8	Inserting the refill set.....	2-9
Fig. 2-9	Attaching the universal condenser.....	2-10
Fig. 2-10	Axioskop 40.....	2-11
Fig. 2-11	HBO 100 W transformer (front and back).....	2-11
Fig. 2-12	Removing the lamp housing	2-12
Fig. 2-13	Inserting the 12 V, 35 W halogen lamp	2-12
Fig. 2-14	Attaching the HBO 103 illuminator.....	2-13
Fig. 2-15	HBO 100 W transformer	2-13
Fig. 2-16	Adjustment guide	2-14
Fig. 2-17	Adjusting the HBO 103	2-14
Fig. 2-18	HBO 103 focal spot before rough adjustment.....	2-15
Fig. 2-19	HBO 103 focal spot after rough adjustment.....	2-15
Fig. 2-20	Focal spot image without adjustment guide on mechanical stage.....	2-16
Fig. 2-21	Attaching HBO 50.....	2-17
Fig. 2-22	Adjusting HBO 50	2-17
Fig. 2-23	Changing the condenser	2-19
Fig. 2-24	Inserting stops and neutral filter	2-20
Fig. 2-25	Attaching the filter mount.....	2-21
Fig. 2-26	Attaching polarizer D	2-21
Fig. 2-27	Attaching overview adapter.....	2-22
Fig. 2-28	HBO 100 W transformer	2-23
Fig. 2-29	Removing HBO 103 illuminator.....	2-24
Fig. 2-30	Removing HBO 103 housing.....	2-24
Fig. 2-31	Changing the HBO 103 W/2 mercury vapor short-arc lamp	2-25
Fig. 2-32	Changing the burner.....	2-26
Fig. 2-33	Setting the torque.....	2-28
Fig. 2-34	Changing the fixed mechanical stage	2-29
Fig. 2-35	Changing the rotary mechanical stage	2-29
Fig. 2-36	Centering the rotary mechanical stage.....	2-30
Fig. 2-37	Setting the ergo-drive	2-31
Fig. 2-38	Changing the specimen holder	2-32
Fig. 2-39	Changing the binocular tube.....	2-33
Fig. 2-40	Attaching Axioskop connector plate	2-34
Fig. 2-41	Changing the FL P&C reflector module	2-35

Fig. 2-42	Changing the filter set in the FL P&C reflector module	2-36
Fig. 2-43	Installing the filter and beam splitter	2-37
Fig. 2-44	Changing the beam splitter	2-38
Fig. 2-45	Changing the beam splitter	2-38
Fig. 2-46	Beam splitter designation	2-39
Fig. 2-47	Attaching the active co-observation equipment for 2 users.....	2-41
Fig. 2-48	Attaching the multi-observation equipment	2-43
Fig. 2-49	Attaching intermediate tube for image projection	2-44

2 START-UP

The Axioskop 40 / Axioskop 40 FL can be installed, converted and started up by the customer.

However, it is also possible to have the microscope installed or converted by Zeiss service staff for an extra charge.

 Before installing and starting-up the microscope, be sure to carefully read the **notes on instrument safety**.

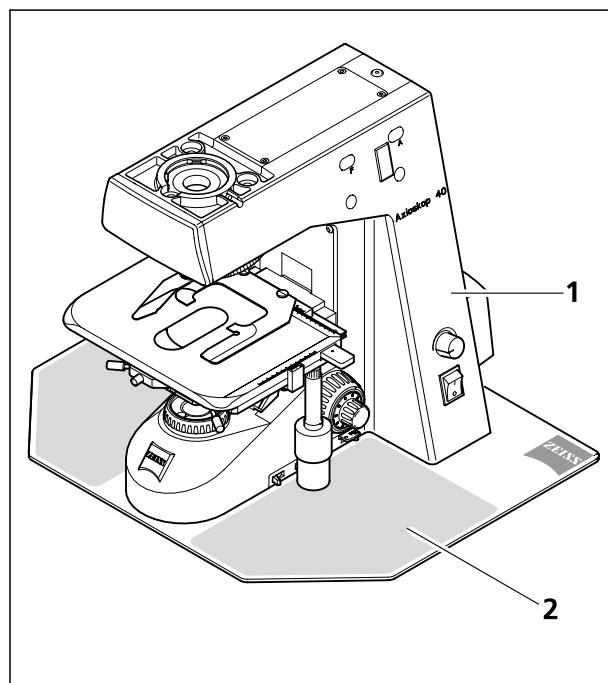
2.1 Initial start-up

2.1.1 Unpacking and installing the microscope

The basic instrument is supplied in a polyethylene case with cardboard packaging.

It contains the following components: Stand with 12 V, 35 W lamp. The binocular tube, objectives, eyepieces, condenser, microscope mat and various small parts, such as spare lamp, dust cover and tool bag and other optional accessories are delivered in a separate package.

The following components are factory-installed to the microscope stand: Mechanical stage, specimen holder, filter mount or overview adapter and, for the Axioskop 40 FL, epi-fluorescence equipment, adjustment guide (if ordered) and P&C reflector modules.



- Remove all components from the packaging and use the delivery form to check for completeness.
- Place instrument (2-1/1) onto the microscope mat (2-1/2) on a vibration-free, flat worktable. The area required by the Axioskop 40 microscope mat is some 500 mm x 400 mm (width x depth).
- Dispose of original packaging properly, or keep it for storage or for returning the instrument to the manufacturer.

Fig. 2-1 Setting up the microscope

2.1.2 Attaching binocular tube or phototube

All the binocular tubes listed in the system overview (refer to Section 1.3) can be attached to the Axioskop 40 / Axioskop 40 FL stand as described below.

- Undo hexagonal screw (2-2/3) using the SW3 ball-headed screwdriver. Remove dust caps (2-2/2) from the bottom of the tube and the dovetailed mount (2-2/5) on the stand.
- Hold the binocular tube (2-2/1) or the binocular phototube in a slightly inclined position and attach it to the stand mount (2-2/4). Turn the binocular tube to the observation position required and tighten the hexagonal screw using the ball-headed screwdriver.



CAUTION

Do not hold the tube by the two eyepiece supports when moving it.

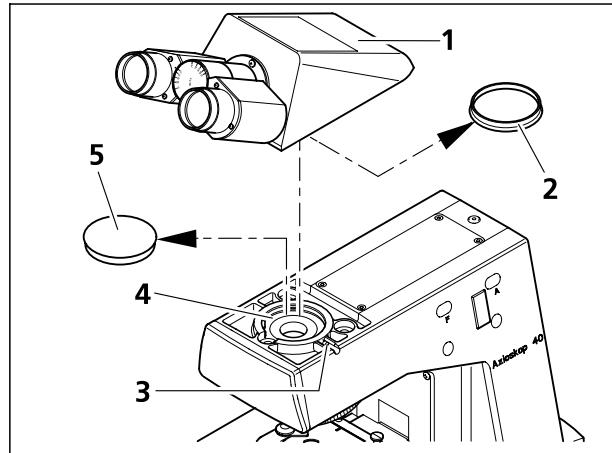


Fig. 2-2 Attaching the binocular tube

2.1.3 Inserting eyepieces and auxiliary microscope

- Remove both dust caps (2-3/1 and 4) from the binocular tube.
- Remove both eyepieces (2-3/2) from their cases and insert them into the binocular tube as far as they will go.
- The auxiliary microscope (2-3/3), which is used to view aperture/phase/VAREL/dark-field stops and to center phase/VAREL/dark-field stops, can be inserted into one of the tubes instead of an eyepiece. The adjustable lens enables you to focus on these stops.

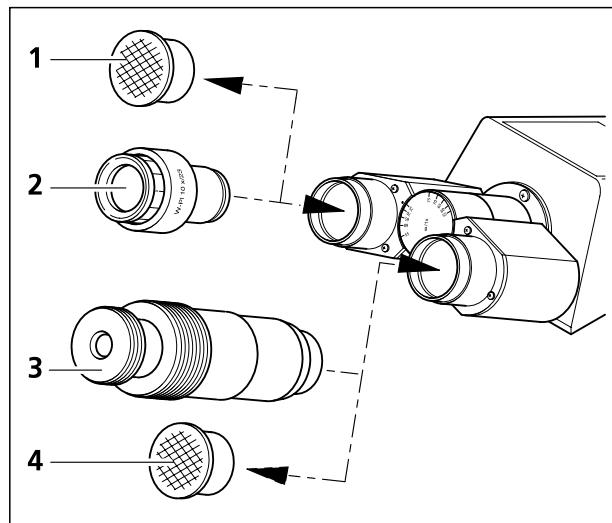


Fig. 2-3 Inserting eyepieces



The eyepieces W-PL 10x/23 Br. foc. and PL 10x/23 Br. foc. can be used with the tubes offered (refer to Section 1.5).

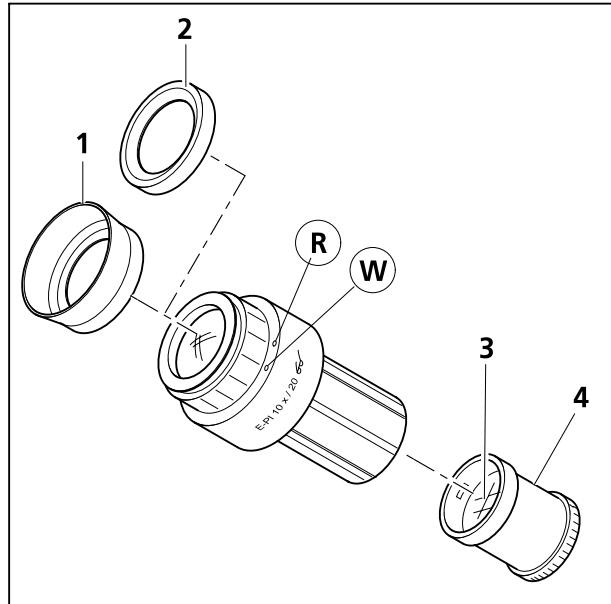


Fig. 2-4 Inserting the eyepiece reticule

Inserting the eyepiece reticule

The PL 10x/23 Br. foc. eyepieces are intended for use with eyepiece reticles.

The slight image shift caused by the additional path through glass is taken into account on the diopter scale by the fact that the zero point position is indicated not by the white dot (2-4/W), but by the red dot (2-4/R).

The eyepiece reticles (2-4/3) have been adhered to screw-in mounts (2-4/4) by the manufacturer for easy replacement. Complete mounts with reticles adhered can be ordered directly from Zeiss.

To change the mount, proceed as follows:

- To replace an eyepiece reticle, unscrew the mount (2-4/4) with eyepiece reticule (2-4/3) from the eyepiece. Replace it with a new mount containing the eyepiece reticle required.

 If you insert eyepiece reticles into the unscrewed mount, take care to ensure that the labeling is visible the right way up after insertion.

Compensation of ametropia when eyepiece reticles are used

Correct use of an eyepiece reticule requires two focusing eyepieces, e.g. PL 10x/23 Br. foc., to enable the user to compensate for differences in the visual acuity of his or her eyes.

- Use the focusing lens of the adjustable eyepiece to focus on the line figure of the eyepiece reticule.
- Use the focusing drive to focus on the microscope image of a specimen through the eyepiece with reticule.
- As soon as the microscope image and eyepiece reticule are focused, use the second focusing eyepiece to focus the microscope image for the second eye.

The two microscope images and reticles will now be focused.

From this point in time on, you should focus only with the focusing drive.

Inserting the fold-over eyecups

The eyepieces have a rubber eyeglass protection ring to prevent scratches on spectacles. The eyepieces can be replaced with fold-over eyecups when required.

- Remove the eyeglass protection ring (2-4/2) from the eyepieces and insert the eyecups (2-4/1).

The eyeglass protection rings are set very tightly in the eyepiece groove, so you may need a blunt object to prod them off.

2.1.4 Setting interpupillary distance of the binocular tube

- The eyepiece distance is coordinated with your individual interpupillary distance by swinging the eyepiece tubes symmetrically toward one another (Fig. 2-5).

The interpupillary distance is correct when you see only **one** round image when you look through the two eyepieces!

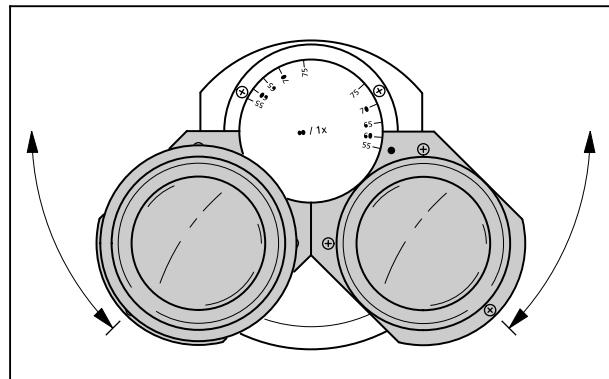


Fig. 2-5 Setting the interpupillary distance of the binocular tube

2.1.5 Setting the viewing height

- The viewing height can be adjusted to individual requirements by swiveling the eyepiece tubes up (2-6/A) or down (2-6/B).

The viewing height also can be changed on the ergonomic binocular phototube (452342-0000-000), by adjusting the viewing angle infinitely variably within a range from 6 to 25°.

The ergo-(photo)tubes (000000-1104-293 and 000000-1104-296) are equipped with continuous height adjustment in the range of 50 mm.

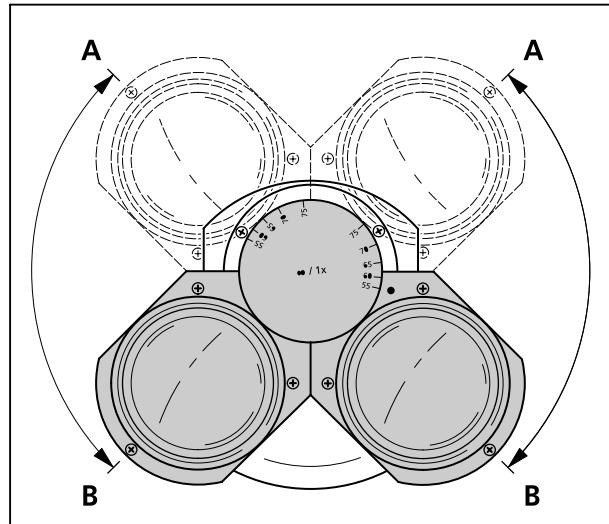


Fig. 2-6 Setting the viewing height of the binocular tube

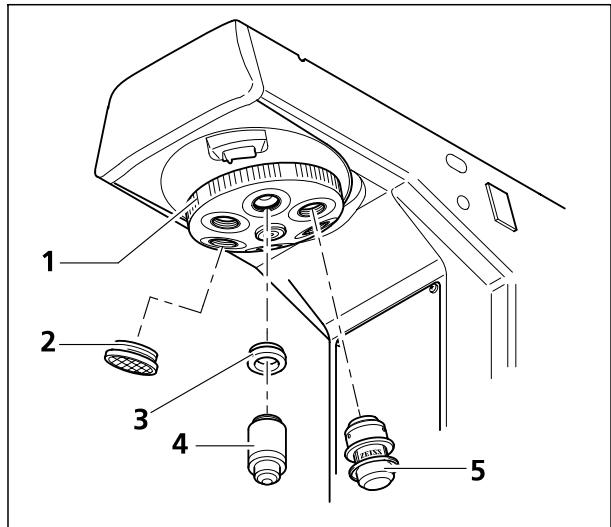


Fig. 2-7 Mounting objectives

2.1.6 Mounting objectives

- Move the mechanical stage with stage carrier to the lower stop position.
- Remove dust caps (2-7/2) from the respective openings on the nosepiece.
- Remove objectives (2-7/4) from the case and screw them into the nosepiece (2-7/1) starting with the lowest magnification (in a clockwise direction).
- The specimen marker (2-7/5) can be inserted in any nosepiece position instead of an objective. Place the protection cap onto the specimen marker during protracted periods when not in use. See section 2.1.7 for further details.

 Take care to ensure the dust protection caps are placed on the nosepiece positions not in use.

Adapter rings (2-7/3) can be placed on the objectives before their insertion into the nosepiece to allow for visual brightness compensation when quickly switching between objectives Type A-Plan, Achroplan and Plan-Neofluar of different magnification. This makes it unnecessary to constantly adjust the lamp voltage when switching objectives.

For magnifications up to 20x, the 000000-1104-290 adapter ring is recommended; it contains a neutral filter with 10% transmission. For magnifications from 20x to <63x, the 000000-1104-289 adapter ring (with 25% transmission) is recommended. For magnifications from 63x to 100x, the 000000-1104-291 adapter ring (without neutral filter) is recommended. A steady brightness impression is possible only when the indicated objective types are placed in the nosepiece; however, the impression is also dependent on the coloring of the specimen.

Since the rings have a height of approximately 5 mm, an adapter ring must be placed on all objective positions.

 The adapter rings are intended only for use with visual applications, since a slight red cast may occur with CCD or photographic images. In addition, use of the ergo-phototube 20°/23 with height adjustment (000000-1104-296) in the higher tube settings may slightly darken the corners of the camera image.

- To use an adapter ring (2-7/3), simply screw it onto the objective and then insert both the objective and ring into the nosepiece.

- Simply reverse the process to remove the adapter ring. If the objective comes out without the adapter ring and the adapter ring is stuck in the nosepiece, then you must screw the objective back into the adapter ring so that both are tightly interlocked. Then be sure to hold both the adapter ring and the objective at the same time to unscrew them together.
- Dirt on the neutral filters of the adapter rings can be cleaned carefully with optical cotton dipped in optical cleaning solution L (also refer to Chapter 4).

2.1.7 Inserting the refill set in the specimen marker

- Unscrew the specimen marker from the nosepiece holding it by the knurled ring on the top section (2-8/1).
- Remove the refill set from the packaging. The refill set consists of a marker insert (2-8/2) and a cover (2-8/5).
- Unscrew top (2-8/1) of the specimen marker.
- If necessary, remove used marker insert from the specimen marker receptacle (2-8/4).
- Insert the new marker insert (2-8/2) without the cover along the 3 metal pins up to the end of the coiled grooves without exerting any pressure (2-8/3). It is best to hold the specimen marker receptacle vertically and allow the marker insert to slide in. Take care to ensure that the top edge of the marker insert rests on the 3 metal pins, otherwise the top cannot be screwed on.
- Screw the top (2-8/1) onto the specimen marker receptacle (2-8/4) and screw the specimen marker back into the nosepiece.
- When necessary, attach the cover.

It is recommended to attach the cover if the marker is not to be used for longer periods. Swing the specimen marker out of the range of the beam when not in use.

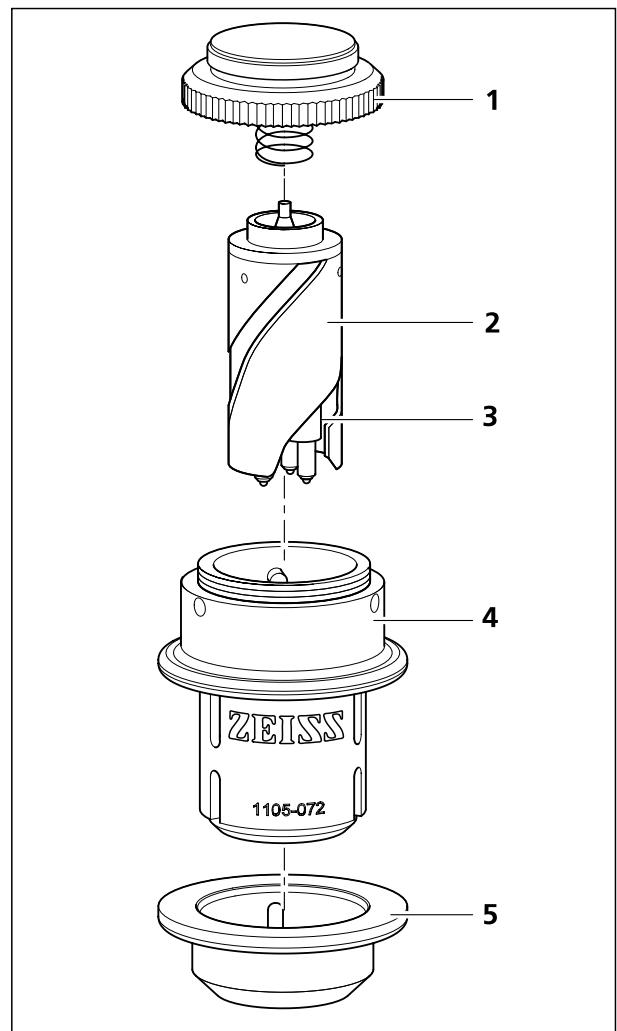


Fig. 2-8 Inserting the refill set

Do not allow the writing surfaces of the marker insert to get wet or dirty.

Before use, store a refill set (marker insert with cover) in its original packaging at 0 to 25 °C and with approx. 50 % relative humidity. It is best stored in a refrigerator at approximately 8 °C.

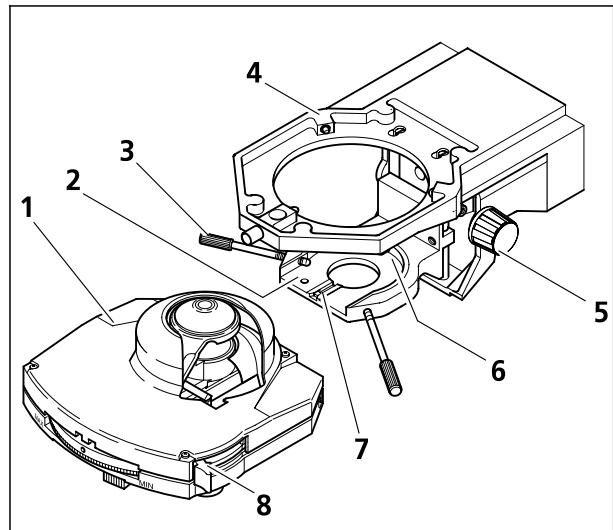


Fig. 2-9 Attaching the universal condenser

2.1.8 Attaching the universal condenser

- Move the stage carrier to the upper stop position via the focusing drive.
- Use lever (2-9/8) to fold out the front lens on the condenser. Undo the two centering screws (2-9/3) until their ends are no longer visible.
- Move condenser carrier (2-9/2) to the lowest position via drive for height adjustment (2-9/5).
- Insert condenser (2-9/1) between condenser carrier (2-9/2) and stage carrier (2-9/4). Orient the locking screw on the bottom of the condenser in the direction of the groove (2-9/7).
- Press the dovetail of the condenser against the spring mount (2-9/6) of the condenser carrier until the condenser can be placed horizontally onto the condenser carrier.

- Let the condenser go smoothly; the locking screw will lock in position in front of the groove (2-9/7).
- Screw in centering screws until they engage in the dovetail of the condenser.

 Proceed in the same manner when attaching other condensers (e.g. condenser 0.9/1.25 H with slider for Ph, H, Var).

2.1.9 Connecting to power

- Connect microscope socket (2-10/2) to a power outlet via a cable. The microscope can be connected to a voltage between 100 and 240 VAC, 50...60 Hz. The power unit is set **automatically** to the line voltage available within this range.
- The HBO 100 illuminator (for epi-fluorescence) receives power from a separate transformer. The HBO 100 W transformer must be connected to a power outlet via its power socket (2-11/2) (only for the Axioskop 40 FL).

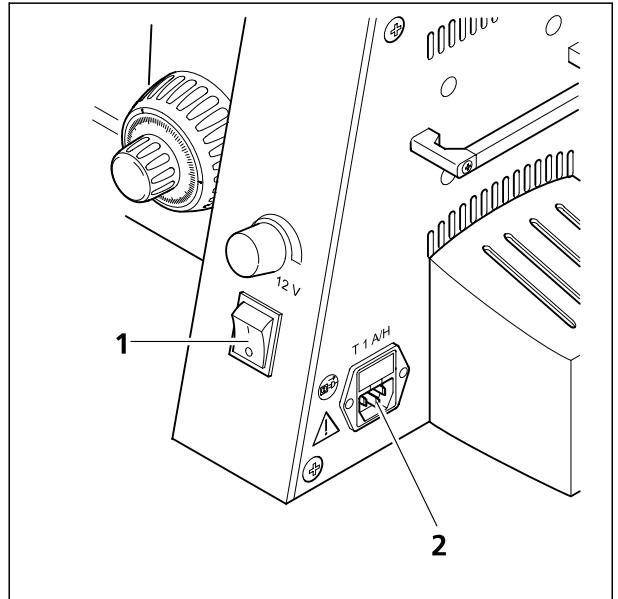


Fig. 2-10 Axioskop 40

2.1.10 Switching the microscope and HBO 100 W transformer on and off

- Switch the microscope on and off using power switch (2-10/1).
- For the Axioskop 40 FL, switch the HBO 100 W transformer on and off using the power switch (2-11/1).

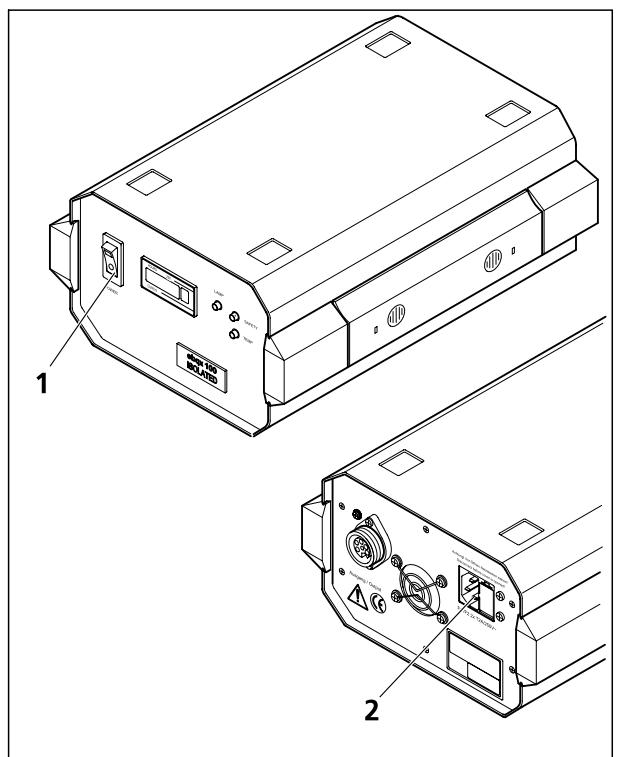


Fig. 2-11 HBO 100 W transformer
(front and back)

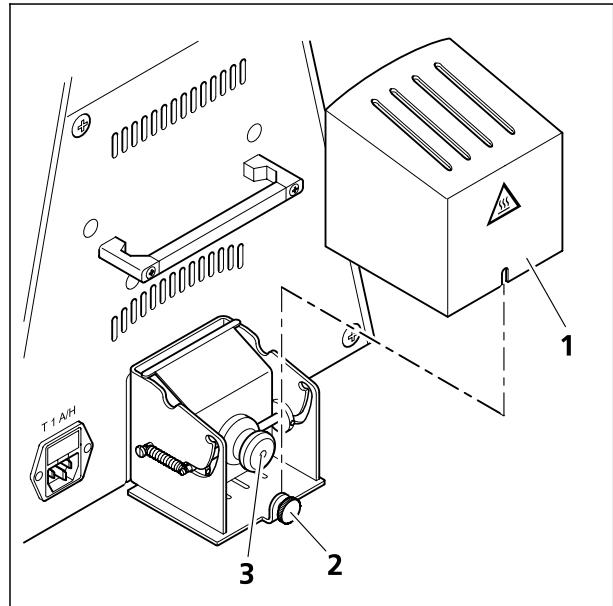


Fig. 2-12 Removing the lamp housing

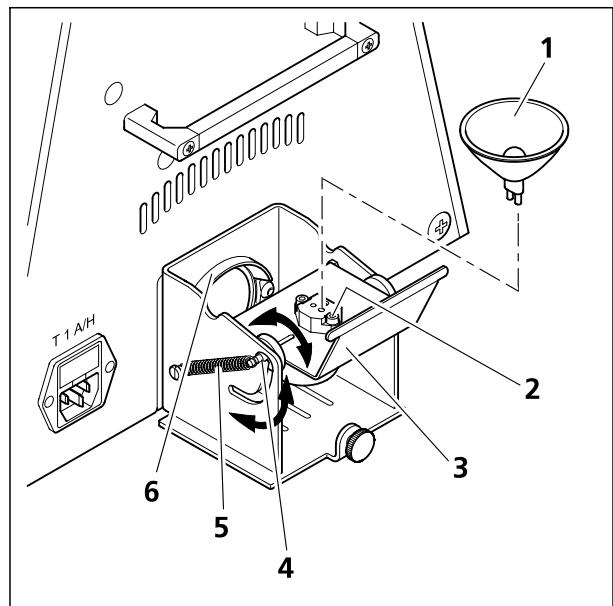


Fig. 2-13 Inserting the 12 V, 35 W halogen lamp

2.1.11 Inserting and replacing the 12 V, 35 W halogen lamp

- Remove the power cable from the microscope.
- Turn off the microscope and allow it to cool down for some 15 minutes.
- Undo the knurled screw (2-12/2) and pull up the lamp housing (2-12/1).
- Hold the lamp carrier (2-13/3) by the knob (2-12/3), pull it forward and move guide axis (2-13/4) into the top click-stop position.
- Swivel lamp carrier (2-13/3) backwards, so you have access to the lamp holder (2-13/2).
- Remove the used lamp (when replacing it) by pulling it up out of the lamp holder (2-13/2) without tilting it.
- Push new lamp (2-13/1) with its two socket pins carefully and without force into the lamp holder (2-13/2). Do not touch the front protective glass on the lamp. The lamp must not be tilted, otherwise the socket pins may be bent or the lamp holder damaged.
- Swivel the lamp carrier forward again (2-13/3) until it makes contact.
- Then pull lamp carrier (2-13/3) from the top click-stop position and move it to the bottom position. Take care to ensure that the guide axis is not tilted so that it does not become jammed. The springs (2-13/5) will center the lamp.
- Wiggle the knob slightly to ensure that the lamp is lodged exactly in the compartment funnel (2-13/6).
- Replace lamp housing (2-12/1) and lock with knurled screw (2-12/2).
- Reconnect power cable.

2.1.12 HBO 103 illuminator (Axioskop 40 FL)

(1) Inserting the HBO 103 W/2 mercury vapor short-arc lamp

The HBO 103 illuminator and the HBO 103 W/2 mercury vapor short-arc lamp are delivered separately packaged for safety reasons.

Therefore, inserting the HBO 103 W/2 lamp into the lamp housing is the first step to start up this illuminator.

The process to insert a new HBO 103 W/2 lamp is described in detail in Section 2.2.6, "Changing the HBO 103 W/2 mercury vapor short-arc lamp".

(2) Attaching the HBO 103 illuminator

- Remove cover from the incident-light tube (2-14/1).
- Insert the dovetail of the lamp housing (2-14/3) into the incident-light tube (2-14/1) on the back of the instrument and use a SW 3 ball-headed screwdriver to tighten the clamping screw (2-14/2).
- Insert multi-pin plug of the HBO 103 illuminator (2-14/3) into device connector (2-15/1) on the HBO 100 W transformer and secure it with a coupling ring.
- Firstly, connect the power cable to the power socket (2-15/2) on the HBO 100 W transformer, then connect it to a power outlet.

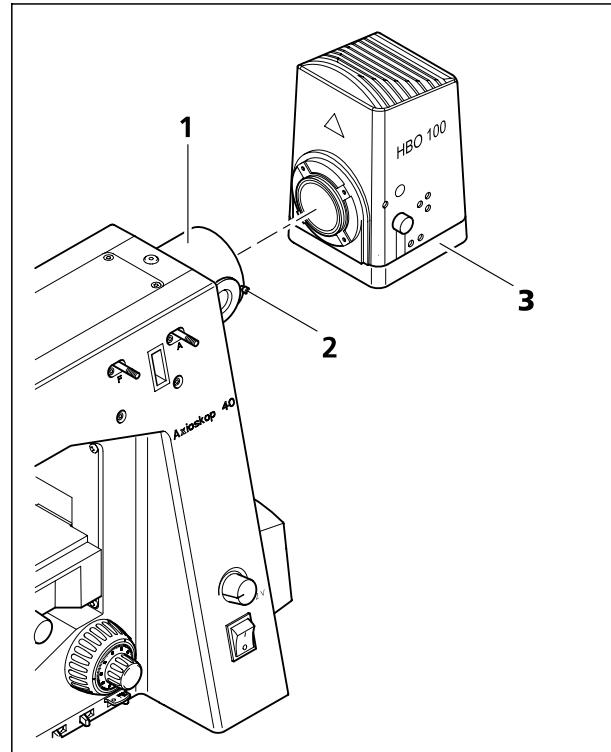


Fig. 2-14 Attaching the HBO 103 illuminator

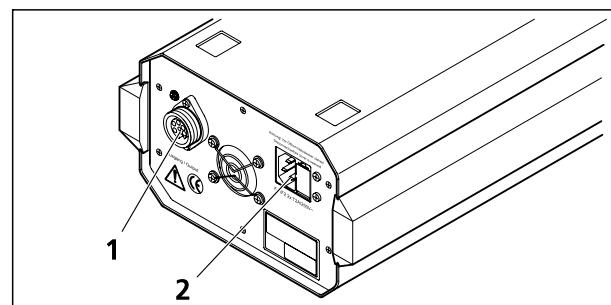


Fig. 2-15 HBO 100 W transformer

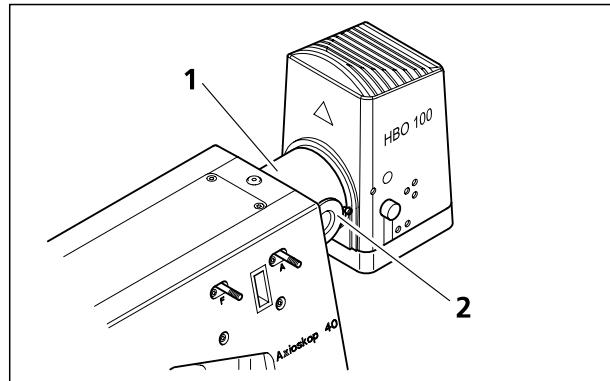


Fig. 2-16 Adjustment guide

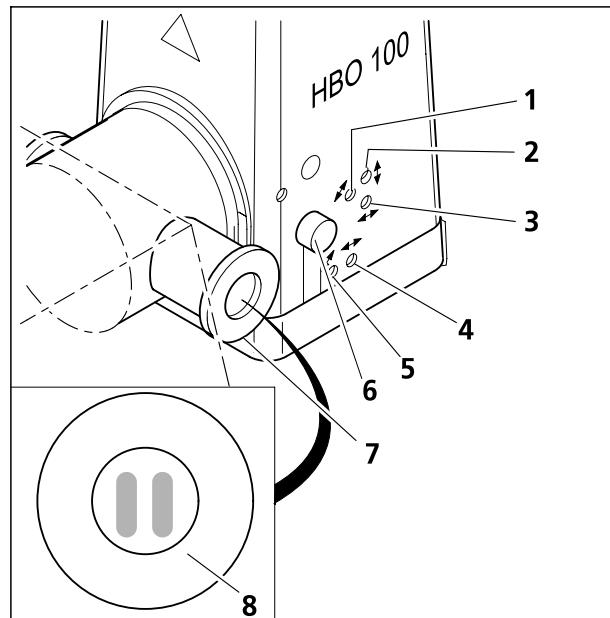


Fig. 2-17 Adjusting the HBO 103

(3) Adjusting the HBO 103 illuminator

Adjustment of the HBO 103 illuminator described below is performed in two steps: Rough adjustment and subsequently fine adjustment. The latter can be performed with or without the adjustment guide (2-16/2) on the incident-light tube (2-16/1).



The adjustment guide must be ordered separately.

Rough adjustment

- Remove the HBO 103 illuminator from the microscope stand by undoing clamping screw (2-14/2).
- Switch on the HBO 103 illuminator via the HBO 100 W transformer (2-11/1) and allow it to warm up to the operating temperature. Take care to ensure you do not look into the illuminator's light-output opening.
- Direct light beam against a projection surface (wall) at least 3 m away. The focal spot should correspond roughly to the image in Fig. 2-18.
- Use the knurled knob for collector adjustment (2-17/6) to focus on the brighter focal spot.
- Use adjusting screw (2-17/4) and the SW 3 ball-headed screwdriver to locate and focus on the slightly darker, reflected focal spot.
- Use adjusting screws (2-17/1 and 3) and the SW 3 ball-headed screwdriver to set the height and side position of the brighter focal spot in the same manner as the focal spot image (refer to Fig. 2-19).



Fig. 2-18 HBO 103 focal spot before rough adjustment

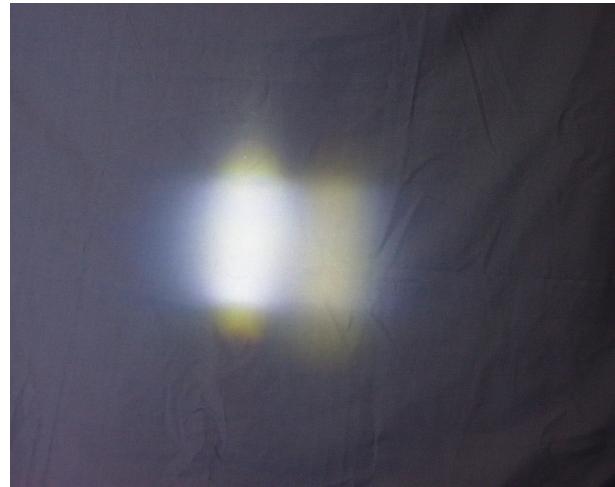


Fig. 2-19 HBO 103 focal spot after rough adjustment



The adjusting screws (2-17/2 and 5) should not be changed during rough adjustment of the focal spots, because they influence the reflector setting in the HBO 103 illuminator. If required, the above settings for rough adjustment of the HBO 103 illuminator can be performed repeatedly.

Fine adjustment using the adjustment guide

- Attach the HBO 103 illuminator to the microscope stand as described in Section 2.1.12 (2).
- Pull adjustment guide (2-16/2) out of incident-light tube (2-16/1). The brighter focal spot of the HBO 103 W/2 lamp and its slightly darker reflector image become visible in the black glass window of the adjustment guide.
- Use the knurled knob for collector adjustment (2-17/6) to focus on the brighter focal spot.
- Use the SW 3 ball-headed screwdriver on adjusting screw (2-17/4) to focus on the slightly darker, reflected focal spot of the lamp.
- If required, set knurled knob (2-17/6) and adjusting screw (2-17/4) alternately until both focal spots have the same dimension or size (refer to Fig. 2-17/8).
- Use adjusting screws (2-17/1 and 3) to adjust the brighter focal spot in the inscribed adjustment circle, e.g. on the left side, in the same manner as the focal spot image (2-17/8).
- Use adjusting screws (2-17/2 and 5) to adjust the dark focal spot in the inscribed adjustment circle, e.g. on the right side, in the same manner as the focal spot image (2-17/8).
- Push back the adjustment guide.



The two focal spots of the HBO 103 W/2 lamp must **not** be superimposed on each other in the adjustment circle of the adjustment guide! When required, the above settings for fine adjustment of the HBO 103 illuminator can be performed repeatedly.

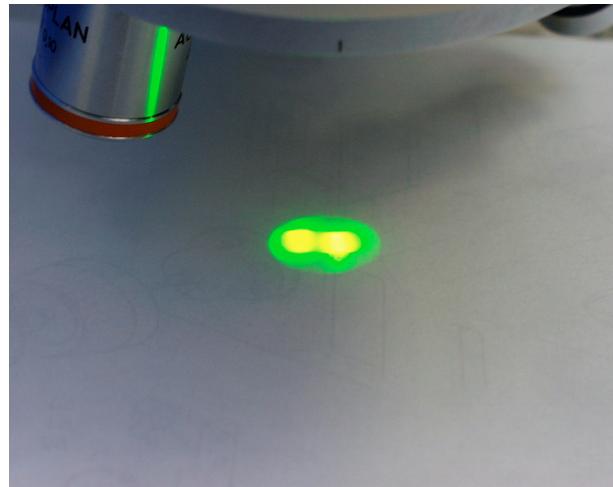


Fig. 2-20 Focal spot image without adjustment guide on mechanical stage

Fine adjustment without adjustment guide

- Attach the HBO 103 illuminator to the microscope stand as described in Section 2.1.12 (2).
- Remove one objective from the nosepiece and switch the empty opening into the function position.
- Place a white sheet of paper onto the mechanical stage.
- Completely open the pre-centered luminous-field and aperture diaphragms in the incident-light illumination beam path.
- The pupil image with the two focal spot images is now visible on the white sheet of paper. When required, reduce the light intensity using attenuation filters in the 3-position or 6-position filter slider.

- Use knurled knob (2-17/6) to focus on the brighter focal spot via the collector adjustment.
- Use the SW 3 ball-headed screwdriver on adjusting screw (2-17/4) to focus on the slightly darker, reflected focal spot of the lamp.
- If required, set knurled knob (2-17/6) and adjusting screw (2-17/4) repeatedly until both focal spots have the same dimension or size.
- Use adjusting screws (2-17/1 and 3) to set the brighter focal spot in accordance with Fig. 2-20.
- Use adjusting screws (2-17/2 and 5) to set the darker focal spot in accordance with Fig. 2-20.

2.1.13 HBO 50 fluorescence illuminator (Axioskop 40 FL)

Attaching the HBO 50 fluorescence illuminator

- Place the HBO 50 fluorescence illuminator (2-21/3) on the connection tube (2-21/1) on the Axioskop 40 FL stand, align and secure it with clamping screw (2-21/2).
- Connect the HBO 50 connection cable to the transformer and the power supply cable to a power outlet.
- Turn the HBO 50 fluorescence illuminator on and off with the power switch on the front of the transformer. The lamp will ignite automatically when switched on.

Adjusting the fluorescence illuminator

Providing the Axioskop 40 FL is fitted with an adjustment guide (to be ordered separately), the HBO 50 can remain attached to the epi-fluorescence illuminator while the burner is adjusted.

- Switch on the completely connected fluorescence illuminator via the transformer. The burner ignites automatically.



If the arc image and reflection are superimposed, the burner will have a higher thermal load, resulting in a shorter service life.

- Pull out adjustment guide (2-22/5). The arc of the burner (lighter) and its reflection (slightly darker) are displayed in the adjustment guide viewing window (2-22/6).

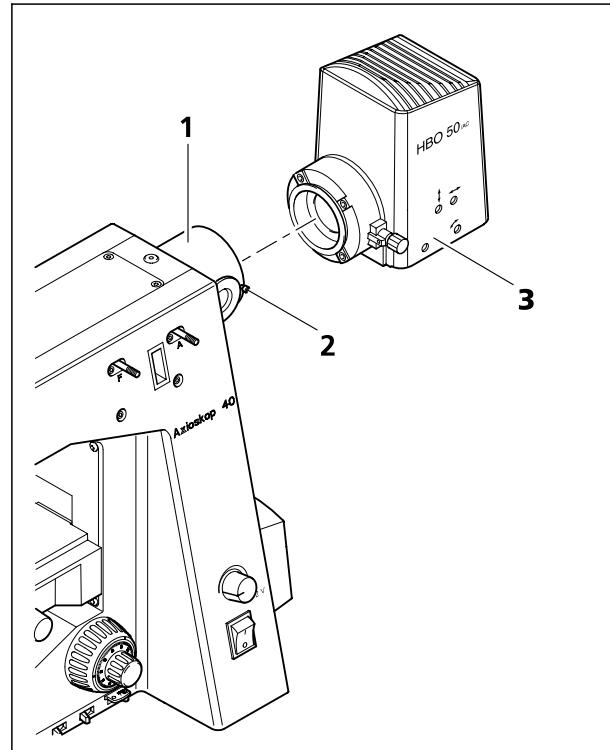


Fig. 2-21 Attaching HBO 50

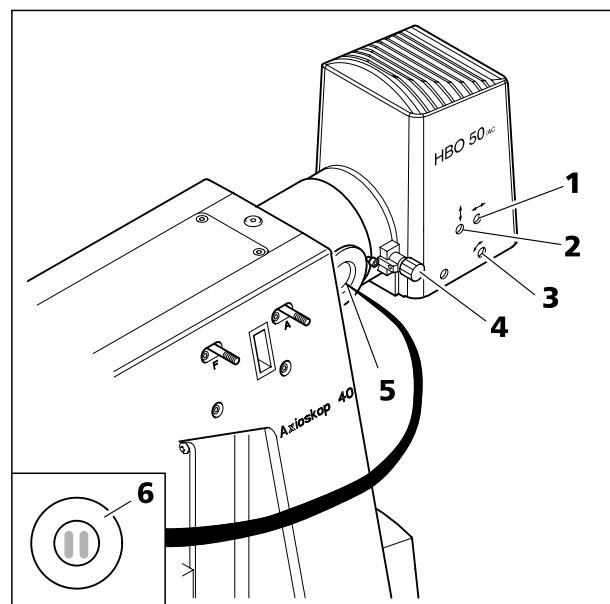


Fig. 2-22 Adjusting HBO 50

- Focus the collector with knurled knob (2-22/4), so that the two arcs are focused clearly.
- Use the adjusting screw (2-22/1) to set the burner in an axial direction to the reflection, so that both arcs appear the same size in the viewing window of the adjustment guide (refer to Fig. 2-22/6).
- Use the adjusting screws for height (2-22/2) and side adjustment (2-22/3) to center the arc and reflection parallel to each other in the adjustment circle of the viewing window (2-22/6). The arc and reflection should not be superimposed on each other.
- After you finish adjusting, focus again with the knurled knob and push the adjustment guide back.

2.2 Attachments and conversions

 This chapter only describes the steps required for attachments to and conversions of the microscope. The corresponding components must be reset to a functioning status as described in Chapters 2 and 3.

2.2.1 Changing the condenser

- Move the stage carrier to the upper stop position via the focusing drive.
- Use lever (2-23/8) to fold out the front lens of condensers with a swiveling front lens.
- Move condenser carrier (2-23/2) to the lowest position via height adjustment drive (2-23/5).
- Undo both centering screws (2-23/3) until the condenser can be easily taken out of its mount.
- Lift the condenser from the orientation groove by slightly tilting it upwards and pull it out to the front.
- Use lever (2-23/8) to fold out the front lens (if available) on the condenser to be newly inserted.
- Insert condenser (2-23/1) between condenser carrier (2-23/2) and stage carrier (2-23/4). Orient the locking screw on the bottom of the condenser in the direction of the groove (2-23/7).
- Press the dovetail of condenser against the spring mount (2-23/6) of the condenser carrier until the condenser can be placed on the condenser carrier horizontally.
- Let the condenser go smoothly; the locking screw will lock in position in front of the groove (2-23/7) at the front.
- Screw in centering screws until they engage in the dovetail.

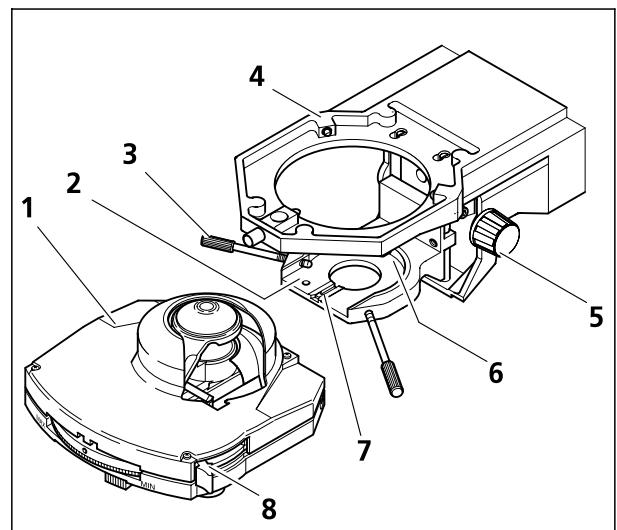


Fig. 2-23 Changing the condenser

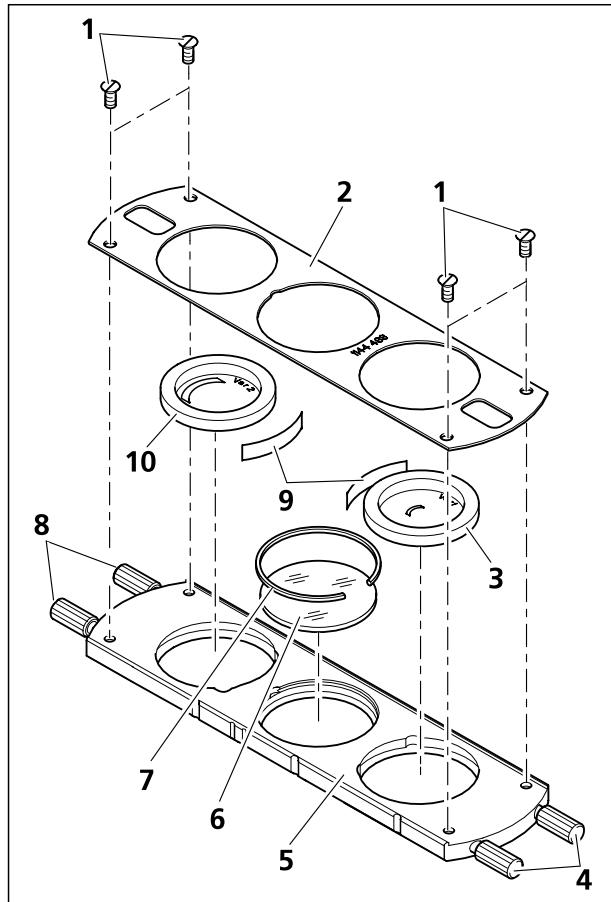


Fig. 2-24 Inserting stops and neutral filter

2.2.2 Inserting stops (Ph, Var) and neutral filter in slider

- Undo the four slot screws (2-24/1) and remove cover (2-24/2).
- Insert stops (2-24/3 or 10) into the left or right position with the metal facing down in the slider (2-24/5). If two VAREL segment stops are concerned, orientate these to the left uniform with the opening. Place one insert each (2-24/9) into the ring gaps.
- Hold the neutral filter (2-24/6) by the sides and insert into the middle of the slider.
- Carefully place spring mount (2-24/7) over the neutral filter and press down until it engages.
- Replace cover (2-24/2) and fasten with four slot screws (2-24/1).
- Place pertinent labels into the gaps on the cover (2-24/2) with the notches at the front.
- Insert slider (2-24/5) into the condenser (notches at the front, cover on top) and allow it to engage.
- Center stops (2-24/3 and 10) with two knurled screws each (2-24/4 and 8), so that the image matches that in Fig. 3-21.

2.2.3 Attaching filter mount

- If necessary, remove the polarizer or overview adapter from the condenser carrier.
- Hold filter mount (2-25/5) parallel to the bottom of the condenser carrier (2-25/3) and screw holding pin (2-25/4) of filter mount (2-25/5) into the front threaded hole to the left below the condenser carrier (2-25/3) as far as it will go using the SW 2 angled Allen key (2-25/6).
- Use adjusting lever (2-25/1) to screw stop bolt (2-25/2) into the rear threaded hole of the condenser carrier as far as it will go.
- Different filters (32 mm) can be inserted in the filter mount, e.g. the white-balance filter. If only one filter is to be used, this can be placed directly on the luminous field diaphragm.

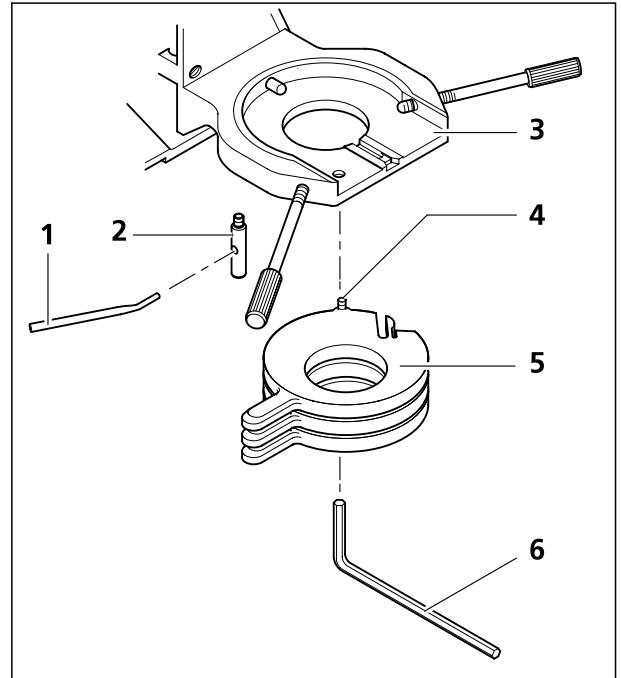


Fig. 2-25 Attaching the filter mount

2.2.4 Attaching polarizer D

- Where necessary, remove the filter mount or overview adapter from the condenser carrier.
- Hold polarizer (2-26/6) parallel to the bottom of the condenser carrier (2-26/3) and screw in holding pin (2-26/4) of the polarizer (2-26/6) with angled adjusting lever (2-26/5) into the front threaded hole to the left below the condenser carrier (2-26/3) as far as it will go.
- Screw in stop bolt (2-26/2) with adjusting lever (2-26/1) as far as it will go into the rear threaded hole of the condenser carrier (2-26/3).

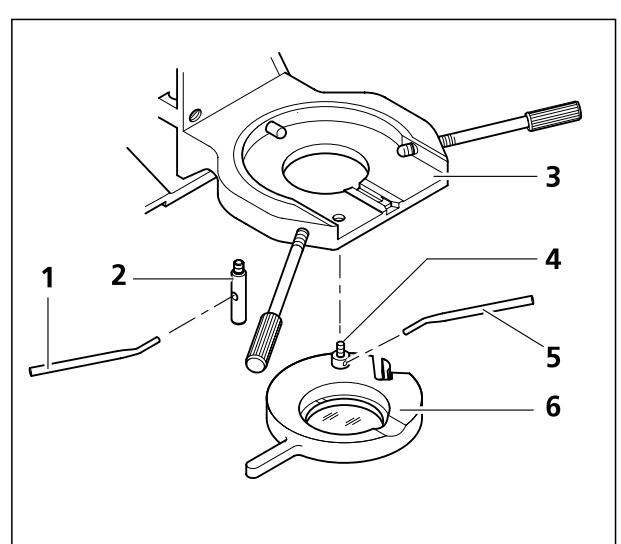


Fig. 2-26 Attaching polarizer D

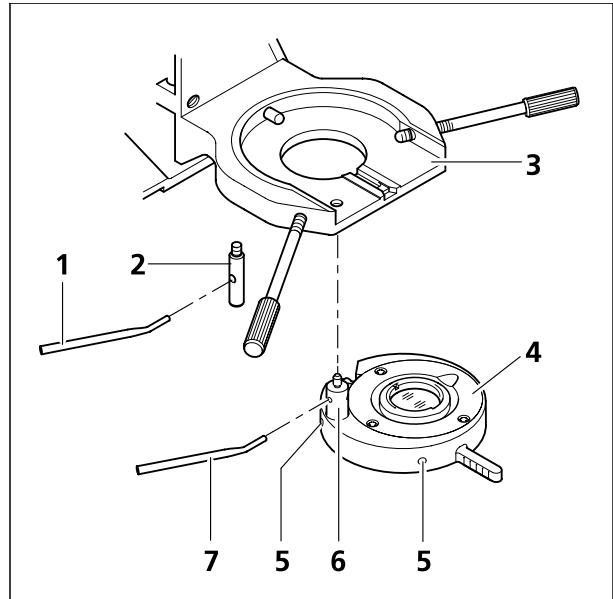


Fig. 2-27 Attaching overview adapter

2.2.5 Attaching overview adapter

- Where necessary, remove the filter mount or polarizer from the condenser carrier.
- Hold overview adapter (2-27/4) parallel to the bottom of the condenser carrier (2-27/3) and screw in holding pin (2-27/6) of the overview adapter with angled adjusting lever (2-27/7) into the front threaded hole to the left below the condenser carrier (2-27/3) as far as it will go.
- Screw in stop bolt (2-27/2) with adjusting lever (2-27/1) as far as it will go into the rear threaded hole of condenser carrier (2-27/3).

Centering the overview adapter

- Swivel overview adapter into the beam path. Take care to ensure that it is properly engaged.
- Open the aperture and luminous-field diaphragm completely.
- Reset the two adjusting screws (2-27/5) with two Allen screwdrivers (SW 1.5) until the field of view is optimally illuminated.

2.2.6 **Changing the HBO 103 W/2 mercury vapor short-arc lamp**



Before opening the lamp housing, ensure that there is no connection to the electrical mains.



HBO 103 W/2 lamps may only be changed after they have cooled down. Allow the HBO 103 microscope illuminator to cool down for some 15 minutes to avoid the risk of burns.

The HBO 103 W/2 lamp may only be removed from the packaging and inserted into the HBO 103 illuminator if a protective mask and safety gloves are worn.

All electrical terminal connections must be made carefully. Pronounced heat during operation may result in contacts loosening.

After the average operating time of 300 h has expired, the HBO 103 W/2 mercury vapor short-arc lamp must be replaced.

The lamp's operating time can be checked on the counter (2-28/1) of the HBO 100 W transformer.

Follow the operating steps below to change the HBO 103 W/2 lamp:

- Disconnect the power plug and the HBO 103 plug from the HBO 100 W transformer.
- Wear a protective mask and safety gloves.

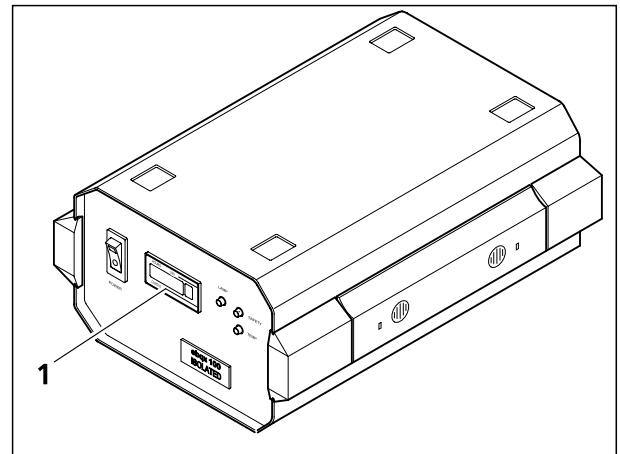


Fig. 2-28 HBO 100 W transformer

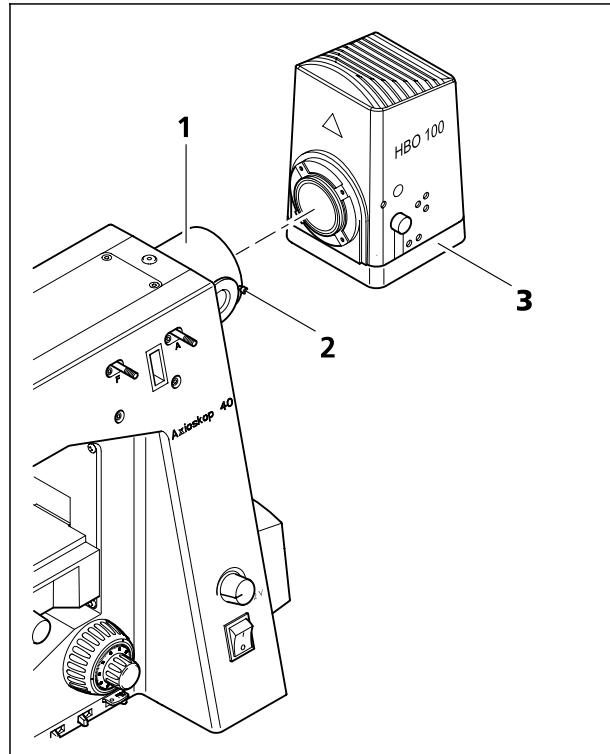


Fig. 2-29 Removing HBO 103 illuminator

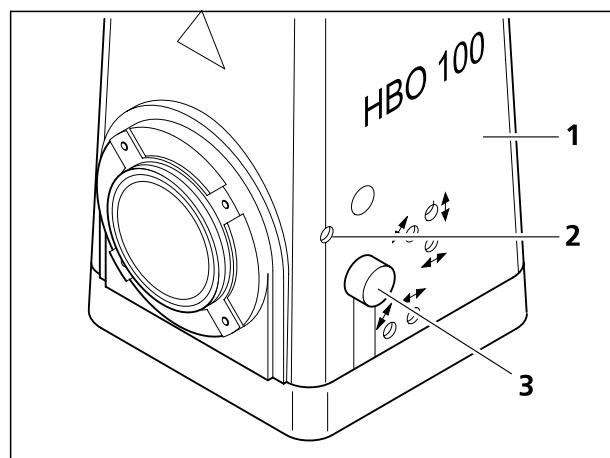


Fig. 2-30 Removing HBO 103 housing

- Use the SW 3 ball-headed screwdriver to undo clamping screw (2-29/2) and remove HBO 103 illuminator (2-29/3) from the incident-light tube (2-29/1) on the microscope stand.
- Use focusing knob (2-30/3) to bring the collector to the frontmost position (in the direction of the light).
- Use a ball-headed screwdriver to undo the clamping screw for lamp housing (2-30/2) and carefully remove lamp housing (2-30/1) upwards from the lamp holder (2-31/3).
- Press down the spring lever (2-31/4) and remove the spent lamp (and transport locking pin) with the heat sink from holder (2-31/2) in the lamp holder (2-31/1). There is no need to remove the wire connection.
- Undo fixing screw (2-31/5) on heat sink (2-31/6) and pull off the heat sink. If the heat sink does not come off (or cannot be reset), undo the fixing screw completely, screw it into the next hole and press it down on the heat sink.
- Dispose of the spent lamp properly.
- Insert the new lamp with the smaller diameter first into the heat sink as far as it will go.



Pay attention to the correct hole diameter when inserting the lamp and do not apply any force. The holder in the heat sink is marked with **H** (for HBO) or **X** (for XBO).

- Clamp fixing screw (2-31/5) onto the heat sink.
- Insert the new lamp (2-31/1) inside the heat sink with the spring lever (2-31/4) pressed down in the lamp holder (2-31/2) provided in the illuminator mount (2-31/3). Take care to ensure that the cable to the heat sink is free at the side. Release the spring lever. Do not apply force to the lamp.
- Fit the illuminator housing (2-30/1) onto the illuminator mount (2-31/3) and clamp it in place with clamping screw (2-30/2).
- Connect the HBO 103 illuminator plug and power plug to the HBO 100 W transformer.
- Adjust the HBO 103 illuminator as described in Section 2.1.12 (3).

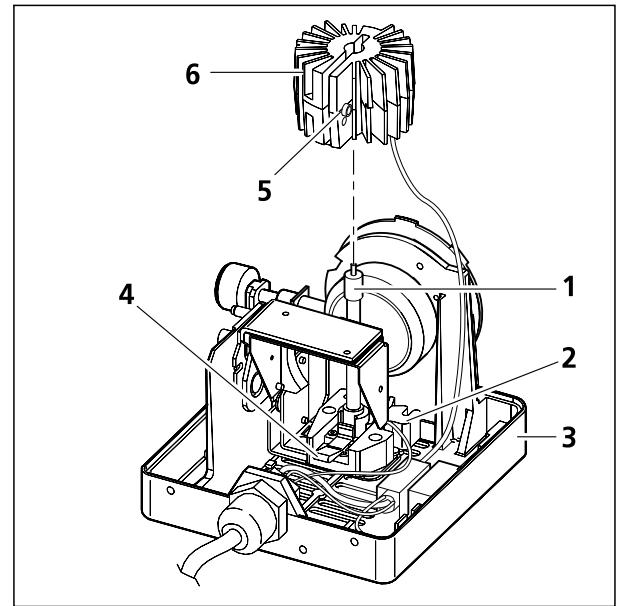


Fig. 2-31 **Changing the HBO 103 W/2 mercury vapor short-arc lamp**

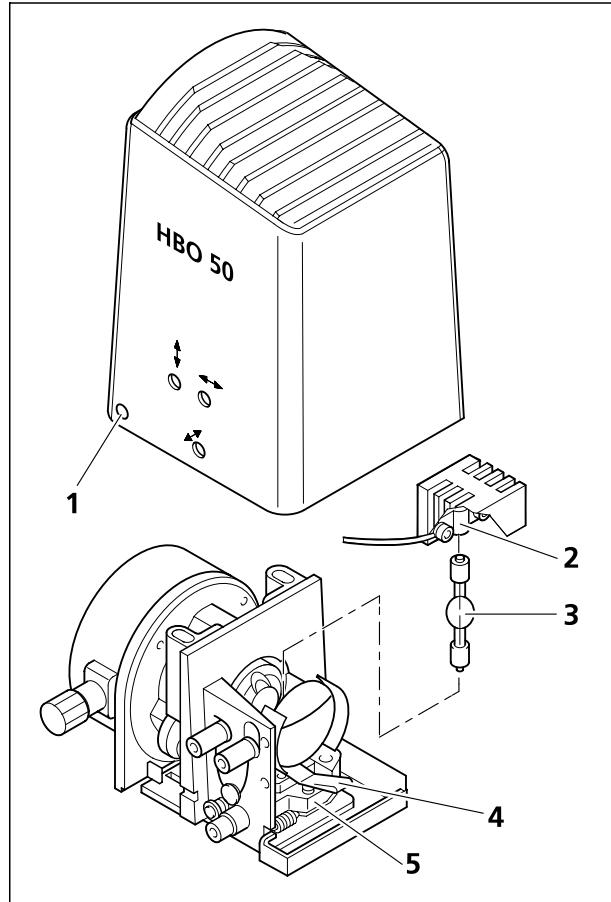


Fig. 2-32 Changing the burner

2.2.7 Changing the burner for the HBO 50 fluorescence illuminator

- Turn off the HBO 50 transformer. Remove the HBO 50 plug from the transformer socket.



Danger of getting burned!
Allow lamp housing to cool down for at least 15 minutes.

- Remove the HBO 50 fluorescence illuminator from the epi-fluorescence component and place it on a working surface.
- Undo clamping screw (2-32/1) with the SW 3 ball-headed screwdriver and remove the lamp housing upwards.
- Press spring lever (2-32/4) down and pull the heat sink (2-32/2) with the burner (2-32/3) up out of the lamp holder (2-32/5). Put the heat sink down, with the clamping screw accessible.



The cable on the heat sink should not be removed.

- Undo the clamping screw on the heat sink with the Allen key and remove the spent burner.



Dispose of the spent burner according to regulations. Observe the manufacturer's instructions!

- Hold the new burner by the labeled metal base and place it into the heat sink, so that the reflective side of the burner faces down when placed into the lamp holder, or, if both sides are reflective, so that the electrode labeled "UP" is on top. If there is a side reflective portion of the burner, it must point to the side in relation to the beam path.
- Tighten the clamping screw on the heat sink carefully.



Avoid fingerprints on the burner's glass parts. Where necessary, remove same immediately.

- Press down spring lever (2-32/4) and insert the burner with the heat sink into lamp holder (2-32/5). Take care to ensure you only hold the heat sink.
- Slowly let go of the spring lever and release the heat sink.



The heat sink must be aligned parallel to the lamp base. To align it, press the spring lever and turn the heat sink with the burner in the lamp holder.

- Replace the lamp housing and tighten clamping screw (2-32/1). Log the number on the operational hour counter.



The burner must be replaced after it attains its service life of 100 hours.

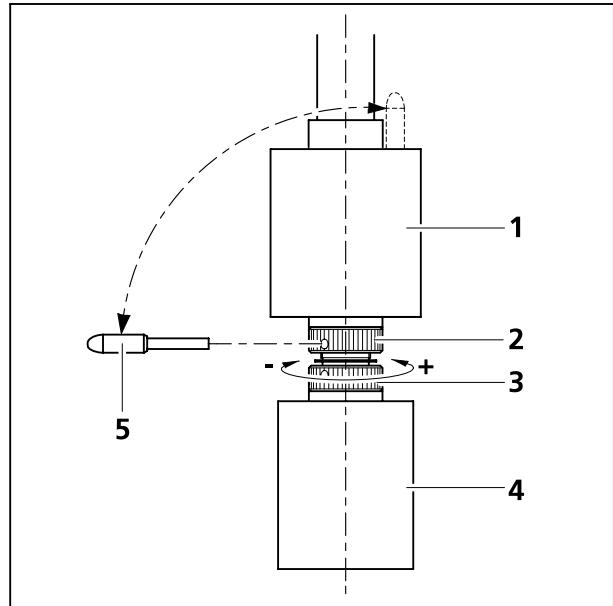


Fig. 2-33 Setting the torque

2.2.8 Mechanical stage with torque setting

The Axioskop 40 / 40 FL stand is delivered with a factory-installed mechanical stage with torque setting. The specimen holder with single-handed operation is attached to the standard mechanical stage (000000-1104-300). Travel range and torque for the x and y setting can be individually varied.

(1) Setting travel range on the stage drive

The travel range of the x and y drives can be changed within a range of approx. 15 mm by moving the designated drive knob (2-33/4 or 1).

(2) Setting the torque for the x/y drive knobs on the mechanical stage

The torque for the drive knobs is set to an average value at the factory. The setting can be changed as follows:

a) X drive

- Push drive knob for x adjustment (2-33/4) all the way down.
- Remove the enclosed adjustment pin (2-33/5) from the drive knob for y adjustment (2-33/1) and place it into one of the holes in the bottom nut (2-33/3).
- Hold the drive knob for x adjustment (2-33/4) and turn the nut with the adjustment pin clockwise (lesser torque: -) or counterclockwise (greater torque: +) until the desired adjustment is reached (refer to Fig. 2-33).
- Do not adjust by more than **one** complete rotation.

b) Y drive

- Push the drive knob for y adjustment (2-33/1) all the way up.
- Place adjustment pin (2-33/5) into one of the openings in the top nut (2-33/2).
- Hold the drive knob for y adjustment (2-33/1) and turn the nut with the adjustment pin clockwise (lesser torque: -) or counterclockwise (greater torque: +) until the desired adjustment is reached.
- Do not adjust by more than **one** complete rotation.
- Place the adjustment pin back into the drive knob for y adjustment (2-33/1).

2.2.9 Changing the mechanical stage

Mechanical stages can be bolted on or turned and centered depending on their type. The range of movement in the x direction is 75 mm and in the y direction 50 mm. Fixed stages with drive to right or left are available. The drive is to the right on the rotary mechanical stage.

(1) Fixed mechanical stage 75x50 R

a) Removing the stage

- Undo 4 fastening screws (2-34/5) on stage carrier (2-34/6) using SW 3 Allen key (2-34/4).
- Remove stage (2-34/1) upwards from the stage carrier.

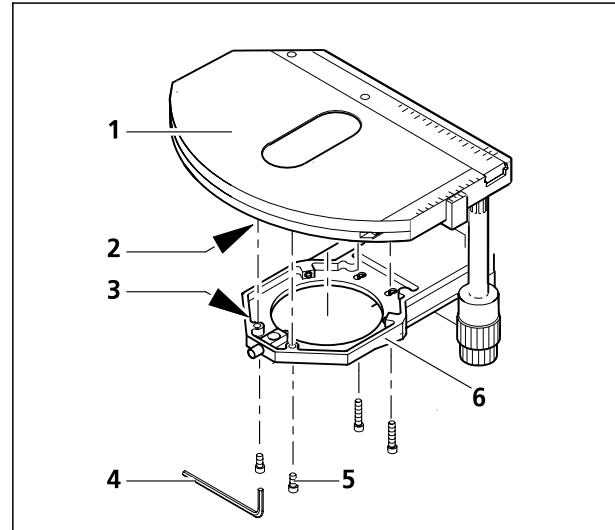


Fig. 2-34 Changing the fixed mechanical stage

b) Attaching the stage

- Place stage (2-34/1) onto stage carrier (2-34/6) in such a manner that threaded holes (2-34/2) on the bottom of the stage are positioned above the stage carrier openings (2-34/3).
- Insert four fastening screws (2-34/5) through the stage carrier from below and screw them into the bottom of the stage; use the shorter screws for the front.
- Orient stage in the x-y direction and tighten the fastening screws.

(2) Rotary mechanical stage 75x50/240° R

a) Removing the stage

- Loosen screw cap (2-35/2) from the spring housing with some 3 rotations.
- Press the stage to the front against spring pin (2-35/1), lift it off the stage carrier (2-35/3) from the back and remove it upwards.
- Retighten screw cap (2-35/2).

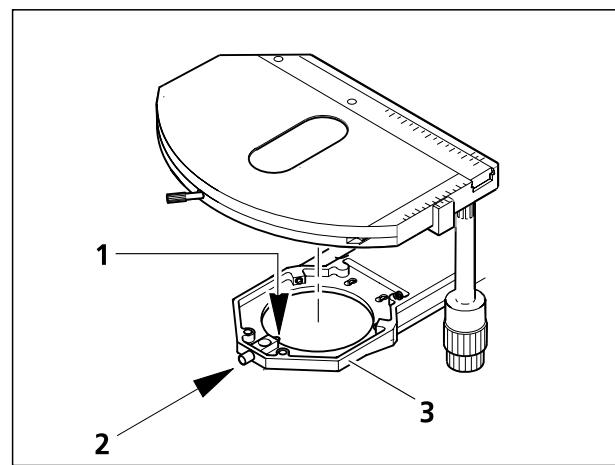


Fig. 2-35 Changing the rotary mechanical stage

b) Attaching the stage

- Loosen screw cap (2-35/2) from the spring housing with some 3 rotations.
- Place the stage with the dovetail groove on the spring pin (2-35/1).

- Press the stage to the front against the spring pin and lower towards the back of stage carrier (2-35/3), then release it.
- Tighten screw cap (2-35/2).

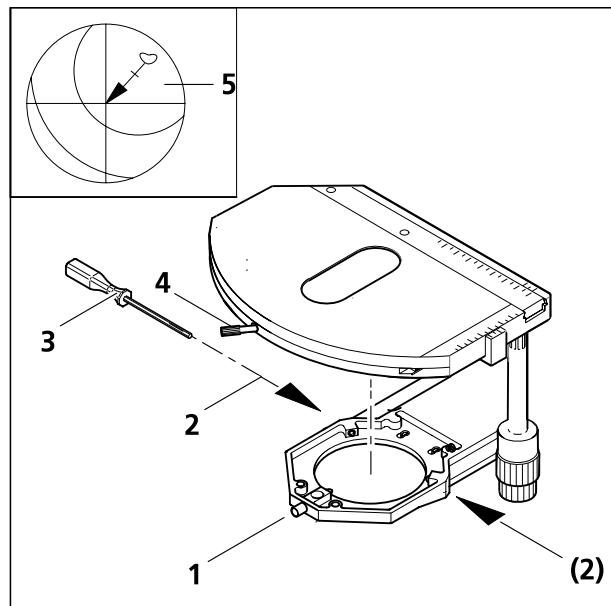


Fig. 2-36 Centering the rotary mechanical stage

c) Centering the stage

When objectives with high magnification are used, centering can be exact for one selected objective only.

All stages are factory-precentered, i.e. a set specimen detail remains in the image center when the stage is rotated. If the image detail moves from the image center (2-36/5) with the stage rotating, recentering should be performed as follows:

- Undo stage clamping screw (2-36/4) and the screw cap on the stage carrier (2-36/1).
- Rotate the stage to determine the maximum specimen deflection (2-36/5, tip of the arrow) in the direction of the eyepiece reticule.
- Reset the two centering screws on the stage carrier (2-36/2) using one SW 1.5 Allen screwdriver (2-36/3) each to move the specimen detail by half the arrow length in the direction of the crossline center. Check whether the specimen detail moves when the stage is rotated again; repeat the procedure, when required.
- When centering is finished, tighten screw cap (2-36/1) again.

The stage can be turned through 240° up to a range of $y \leq 27$ mm. No rotation is possible above this range of movement.

(3) Adjusting the travel range on the ergo-drive

On mechanical stages with ergo-drive, the travel range of **x** and **y** adjustment can be extended by a **max. 15 mm** by axial movement of the drive knobs.

(4) Removing and attaching additional sleeves

The two drive knobs for mechanical stages with catalog numbers 000000-1067-325, 000000-1063-835 and 000000-1067-836 are fitted with additional sleeves, providing an even finer setting of the specimen position. They can be removed if faster specimen movement is more important.

- Firstly, undo the two clamping screws (2-37/4) on the bottom additional sleeve (2-37/3) and remove the latter downwards, then undo the two clamping screws (2-37/2) on the top additional sleeve (2-37/1) and pull it downwards as well.
- Mount the additional sleeves back on the drive knobs in reverse order and tighten both clamping screws.

(5) Setting the torque of the two drive knobs on the ergo-drive

The ergo-drive is set to an average torque value at the factory. This setting can be changed as follows:

a) Adjusting the x direction

- Remove the additional sleeves (2-37/1 and 3) from the drive knobs when necessary. Undo the clamping screws to do so.
- Push the x drive knob (2-37/5) down and the y drive knob (2-37/7) up.
- Hold the x drive knob (2-37/5) and turn the light knurled ring (2-37/6) above it clockwise (easy action) or counterclockwise (sluggish action) until the desired torque is achieved.

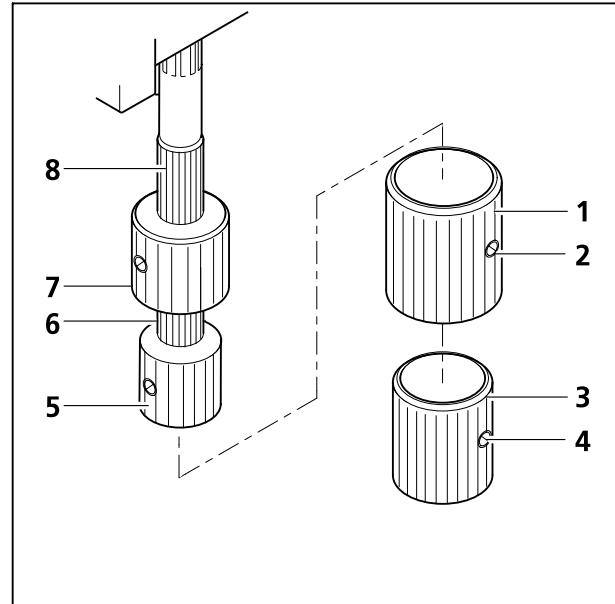


Fig. 2-37 Setting the ergo-drive

b) Adjusting the y direction

- Hold the y drive knob (2-37/7) and turn the light knurled sleeve (2-37/8) above it clockwise right (sluggish action) or counterclockwise (easy action) until the desired torque is achieved.
- Replace the additional sleeves when necessary and tighten the clamping screws.

 To ensure the stage's long service life, remove the build-up from the carrier plate at regular intervals. Make sure that the build-up does not get into the guiding components for x adjustment.

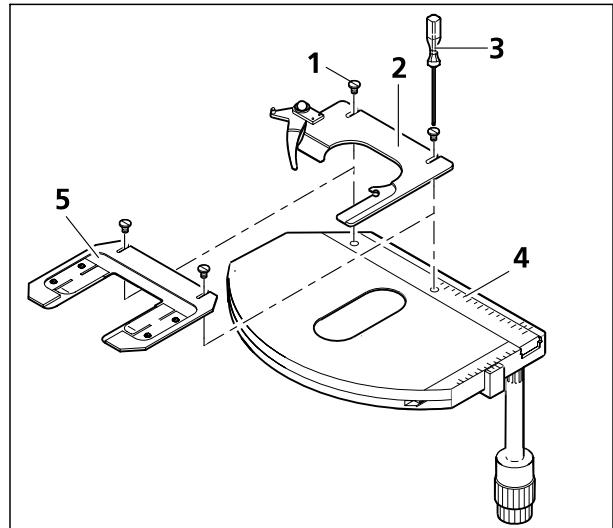


Fig. 2-38 Changing the specimen holder

(6) Changing the specimen holder on the mechanical stages 000000-1046-520, 000000-1067-325, 000000-1063-835, 000000-1063-836

- Undo the two slotted screws (2-38/1) using a screwdriver (2-38/3).
- Remove specimen holder (2-38/2) from the mechanical stage (2-38/4) upwards.
- Attach desired specimen holder (2-38/5) to the mechanical stage and tighten the two slotted screws.

 For technical reasons no other specimen holder than the specimen holder for one-handed operation 000000-1132-489 can be attached to the mechanical stage 000000-1104-300.

2.2.10 Changing the binocular tube

- Use an SW 3 ball-headed screwdriver to undo clamping screw (2-39/3) and remove tube (2-39/1) upwards.
- Place dust cap (2-39/2) for tube lens protection on the dovetail of the binocular tube.
- Remove dust cap (2-39/5) from the desired tube.
- Insert tube (2-39/1) with the dovetail into the stand opening (2-39/4) and align the tube.
- Tighten clamping screw (2-39/3).



CAUTION

When moving the tube, do not hold it by the two eyepiece supports.

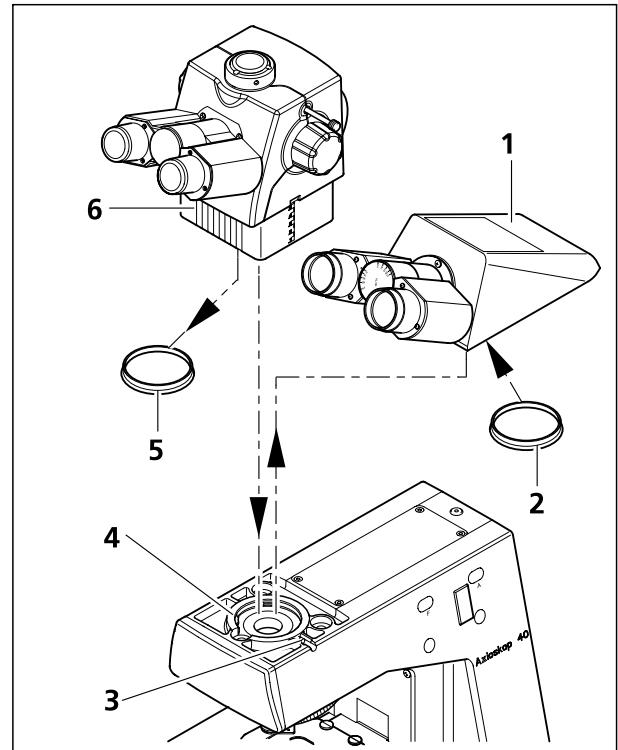


Fig. 2-39 Changing the binocular tube

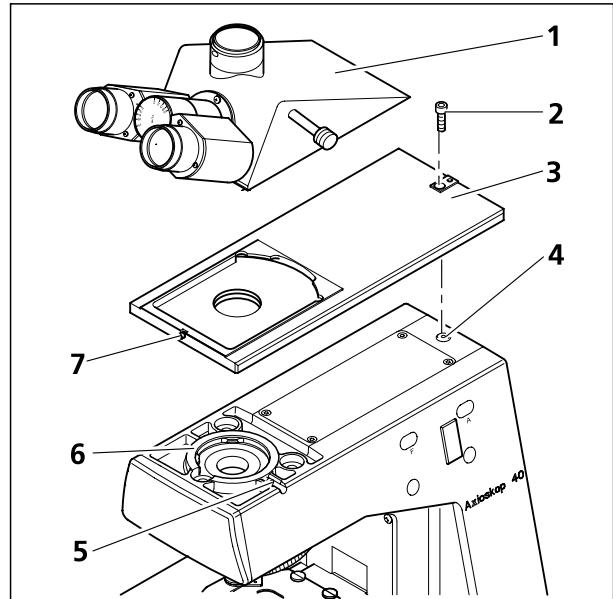


Fig. 2-40 Attaching Axioskop connector plate

2.2.11 Attaching Axioskop connector plate

The Axioskop connector plate is used to attach intermediate tubes and/or tubes from Axioplan 2 to the Axioskop 40 / Axioskop 40 FL.

- Use a SW 3 ball-headed screwdriver to undo clamping screw (2-40/5) and remove the Axioskop 40 / 40 FL tube upwards.
- Insert the Axioskop connector plate (2-40/3) with the dovetail on the bottom into the stand opening (2-40/6) and slightly tighten clamping screw (2-40/5).
- Insert fastening screw (2-40/2) into the countersunk hole of the connector plate (2-40/3) and screw it into the drilled hole (2-40/4) on the stand.
- Tighten clamping screw (2-40/5) and fastening screw (2-40/2).
- Attach desired intermediate tube and/or tube (2-40/1) of the Axioplan 2 to the connector plate and clamp it in place using a screw (2-40/7).
- Insert eyepieces with field number 23 into the Axioplan 2 tube (2-40/1).

2.2.12 Installing and removing "Push&Click" modules on the Axioskop 40 FL

The FL P&C reflector modules and optovar and analyzer modules can only be installed on the Axioskop 40 FL, since its stand is equipped with a reflector turret. The following reflector modules can be installed:

FL P&C reflector module	# 000000-1046-281
Optovar module 1.25x (for transmitted light only)	# 000000-1046-284
Optovar module 1.6x (for transmitted light only)	# 000000-1046-283
Optovar module 2.5x (for transmitted light only)	# 000000-1046-282
Analyzer module D	# 000000-1050-958

Installing a module:

- Pull the cover cap (2-41/1) forwards off the reflector turret.
- Insert the module (2-41/3) with the retaining pins (2-41/4) from above to the left and right of the module at an angle into the spring clamps (2-41/2) on the reflector turret.
- Then press the module at the top until it snaps securely into the top spring clamps of the reflector turret.

Aligning the module when installing it in the reflector turret:

FL P&C reflector module

the excitation filter faces forward; the emission filter faces up

Optovar module

the lens faces up; the empty module opening faces forward

Analyzer module

the analyzer faces up; the empty module opening faces forward

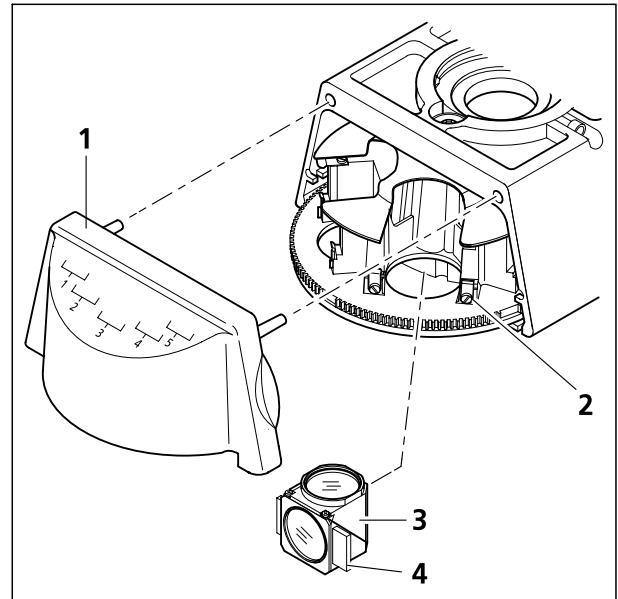


Fig. 2-41 Changing the FL P&C reflector module

Removing a module:

- Tip the module slightly. Pull it firstly out of the top springs and then out of the bottom springs. Remove it completely.
- After removing or installing the reflector modules, insert the cover cap with the two top pins into the stand housing and press until the bottom retaining pins snap in.
- Switch the reflector turret three positions clockwise to swivel the mounted module into the beam path.

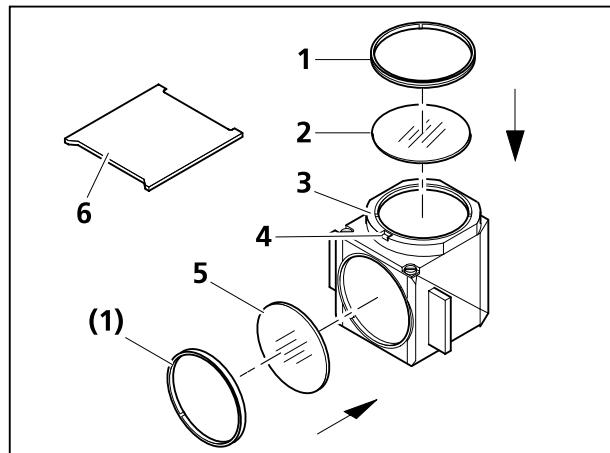


Fig. 2-42 Changing the filter set in the FL P&C reflector module

2.2.13 Changing the filter set in the FL P&C reflector module

The filter sets for the FL P&C reflector module can be combined and assembled individually by the customer. Filter sets or fully assembled FL P&C reflector modules can be ordered from Carl Zeiss.

- Remove FL P&C reflector module (2-42/3) from the reflector turret and set it down (also refer to Section 2.2.12).
- Use mounting device (2-43/6) from the tool set to unscrew retainer ring (2-42/1).
- Turn the reflector module around and allow the filter (2-42/2 or 5) to drop out on a soft surface.
- The emission filter is inserted at (2-42/2), the excitation filter at (2-42/5), and both are secured using the retainer ring (2-42/1).

An arrow and designation can be provided on the circumference of the emission filter and excitation filter. The arrow indicates the direction the particular filter is installed in the reflector module and must always point inwards (refer to arrows in Fig. 2-42).

An additional label can be provided on the emission filter to show the position of the wedge angle in order to minimize image movement during multiple fluorescence procedures.

The label should be aligned on the orientation groove (2-42/4) when the particular emission filter concerned is installed in the reflector modules used. This ensures that the wedge angle of the emission filter is in the same, defined position of the reflector modules, which minimizes the already minimal image shift when Zeiss filter sets are used.

If it is necessary to install filters without direction arrows, we recommend the following procedure:

Filters with reflective, dielectric layers need to be installed, so that the reflective layer (2-43/6) on the excitation filter (2-43/5) points outwards (in relation to the reflector module). With the emission filter (2-43/1), the reflective layer (2-43/2) points inwards (Fig. 2-43).

The reflective layer (2-43/4) of the beam splitter (2-43/3) should point downwards in its installation position.

The arrows (2-43/7) mark the illumination or imaging beam path.

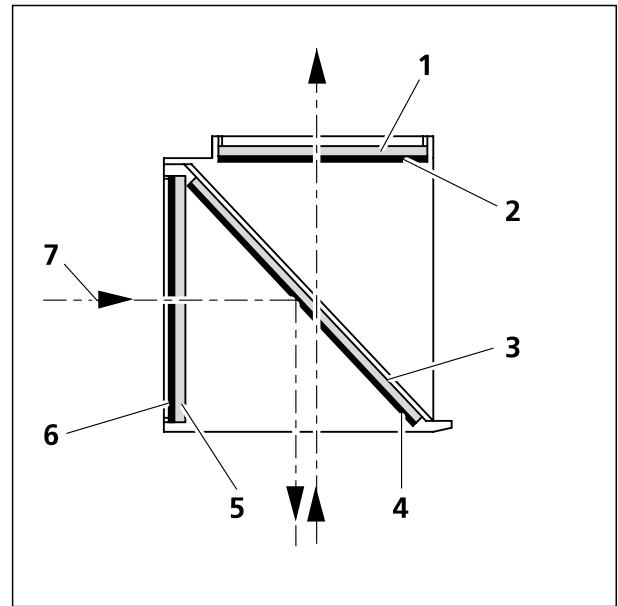


Fig. 2-43 **Installing the filter and beam splitter**

2.2.14 Changing the beam splitter in the FL P&C reflector module



Attachment of filters and the beam splitter requires utmost care to prevent damage to and contamination of the optical components.

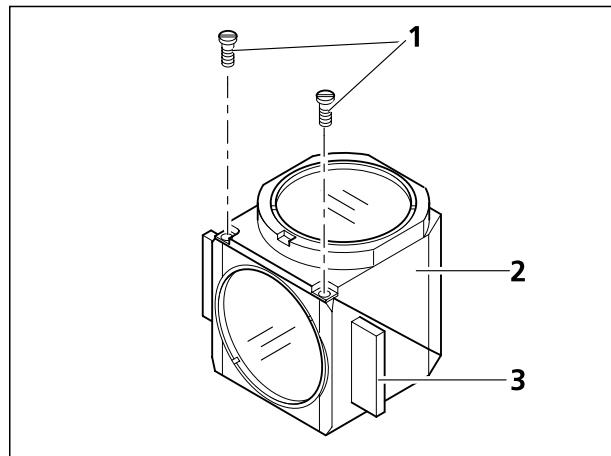


Fig. 2-44 Changing the beam splitter

We recommend ordering completely equipped FL P&C reflector modules, since changing the beam splitter is quite demanding.

However, should you choose to change the beam splitter, proceed as follows:

- Remove the FL P&C reflector module from the reflector turret (also refer to Section 2.2.12).
- Undo the two slotted screws (2-44/1) with a screwdriver.
- Hold both halves of the reflector module together (**emission** half (2-44/2) and **excitation** half (2-44/3)), turn in the opposite direction to the installation position and put it down.
- Tip up the **excitation** half of the module (2-45/1), which now is on top, and remove it from the retaining pins (2-45/5b) on the bottom half of the module (**emission**) (2-45/4).
- Remove the beam splitter (2-45/2) and spring frame (2-45/3) from the bottom half of the module.
- Remove the old beam splitter and carefully place the new one onto the spring frame (2-45/3) with the reflective side facing up and place both parts together into the bottom half of the module. Take care to ensure that the side latch of the spring frame is in the appropriate recess in the bottom half of the module.

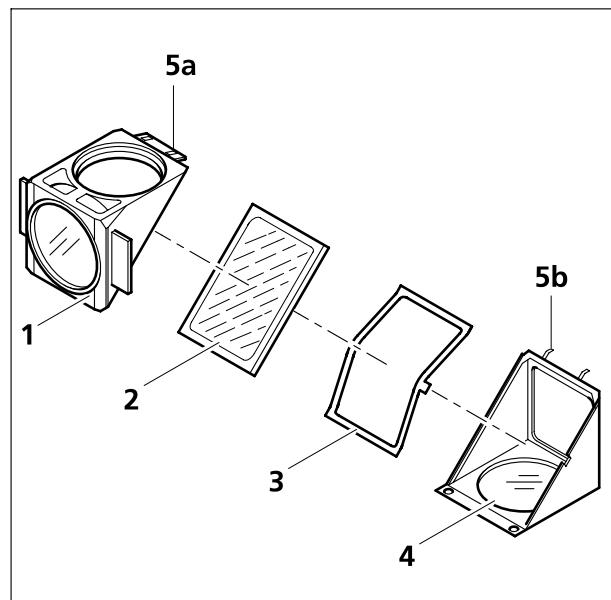


Fig. 2-45 Changing the beam splitter



The reflective (layered) side (2-46/3) of the beam splitter has a slanted edge (2-46/1) or corner (2-46/2).

- Place the **excitation** half of the module (2-45/1) onto the **emission** half of the module (2-45/4) (the retaining pins 2-45/5b will grip the eyelets 2-45/5a). Hold both halves together and turn them back into the installation position.
- Re-insert the slotted screws and tighten them up.
- Finally, attach the adhesive label with the name of the filter combination to the side of the module.

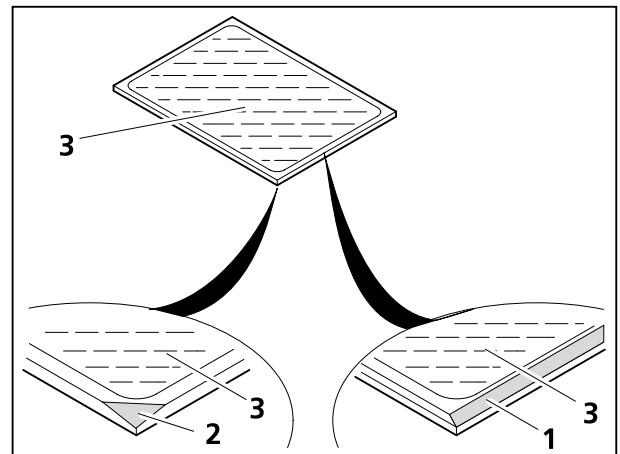


Fig. 2-46 Beam splitter designation

2.2.15 Attaching the active co-observation equipment for 2 users

The active co-observation equipment for 2 users can be attached to the Axioskop 40 stand without restrictions. For the Axioskop 40 FL stand, the incident-light illuminator (e.g. HBO 103) must first be removed.

- Use a SW 3 ball-headed screwdriver to undo clamping screw (2-47/12) and remove available tube upwards.
- Remove dust cap (2-47/14) from the dovetail at (2-47/15) of the co-observation equipment (2-47/16).
- Insert the dovetail of the co-observation equipment in the stand opening (2-47/13) and tighten clamping screw (2-47/12) only slightly at first.
- Align the co-observation equipment with the outer edges of the stand and ensure that the support points on the co-observation equipment (bottom) and the stand (2-47/9) match exactly.
- Then tighten clamping screw (2-47/12) to prevent the co-observation equipment from shifting.
- Unscrew the tube lenses from the two binocular tubes (using the cover of one of the storage cases) and put them into the cases.
- Remove upper dust caps (2-47/3 and 18) from the co-observation equipment.
- Place the ergonomic binocular phototube 6-25°/23 (100/100) (2-47/1) onto the front dovetail (2-47/17) of the co-observation equipment. In addition to the ergonomic binocular phototube, the binocular tube 30°/23 (2-47/2) can be placed onto the rear dovetail (2-47/4). Then align the tubes and tighten with clamping screws (2-47/8 and 19).

The ergonomic binocular phototube 6-25°/23 provide an upright and unreversed image of the specimen in the eyepiece.

- Screw heat protection shield (2-47/6) to co-observation equipment from below using the two fastening screws (2-47/7).
- Insert power unit (2-47/10, 115 V or 230 V) plug (2-47/11) into the socket (2-47/5) on the co-observation equipment and tighten the ring to prevent shifting.
- Connect power unit to a power outlet (115 V or 230 V).

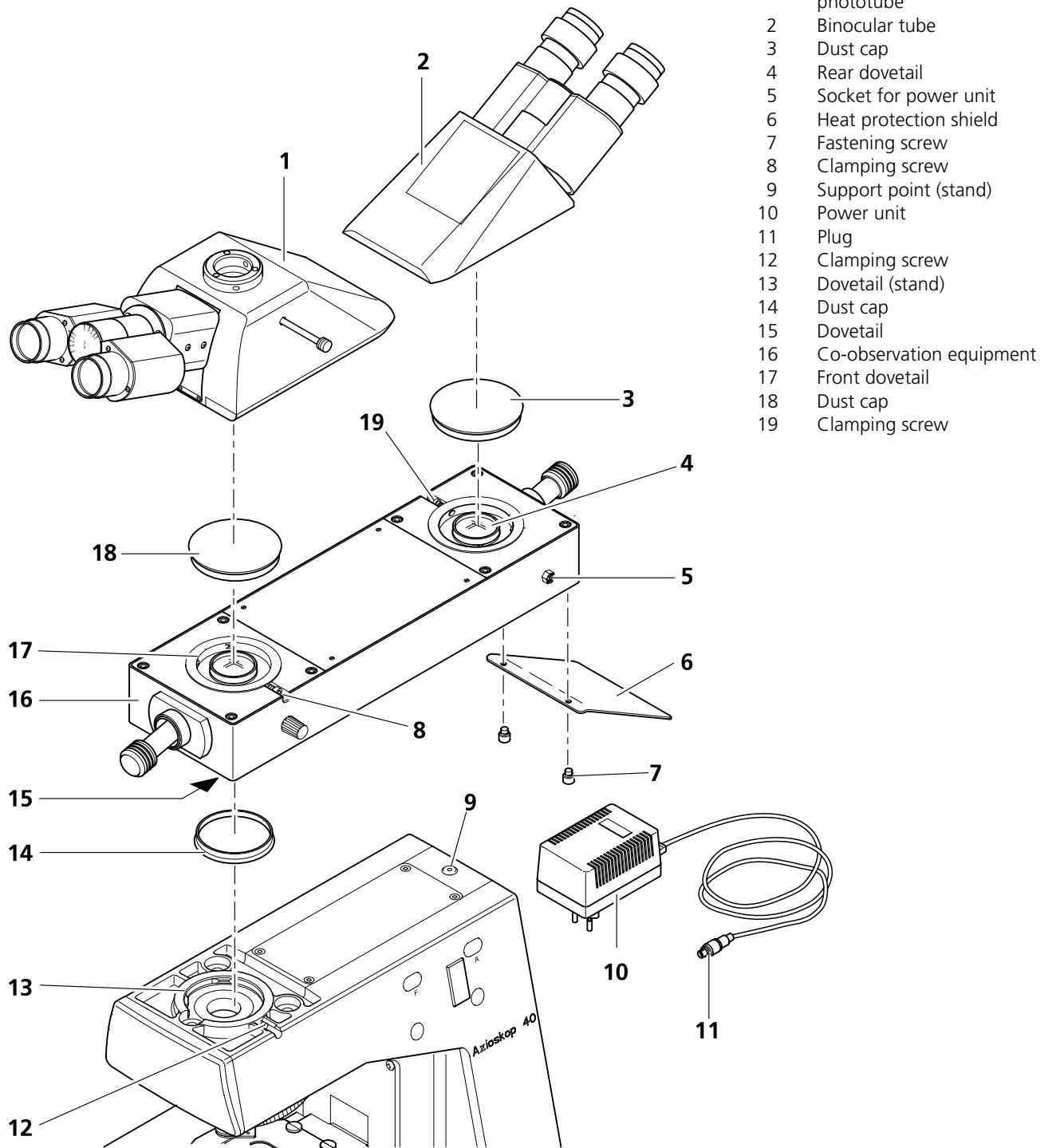


Fig. 2-47 Attaching the active co-observation equipment for 2 users

2.2.16 Attaching the multi-observation equipment

! We recommend that you request Zeiss Microscopy Service to assemble the multi-observation equipment (refer to Chapter 4), since careful optical adjustment and centering of the fields of view of the various observation tubes is required.

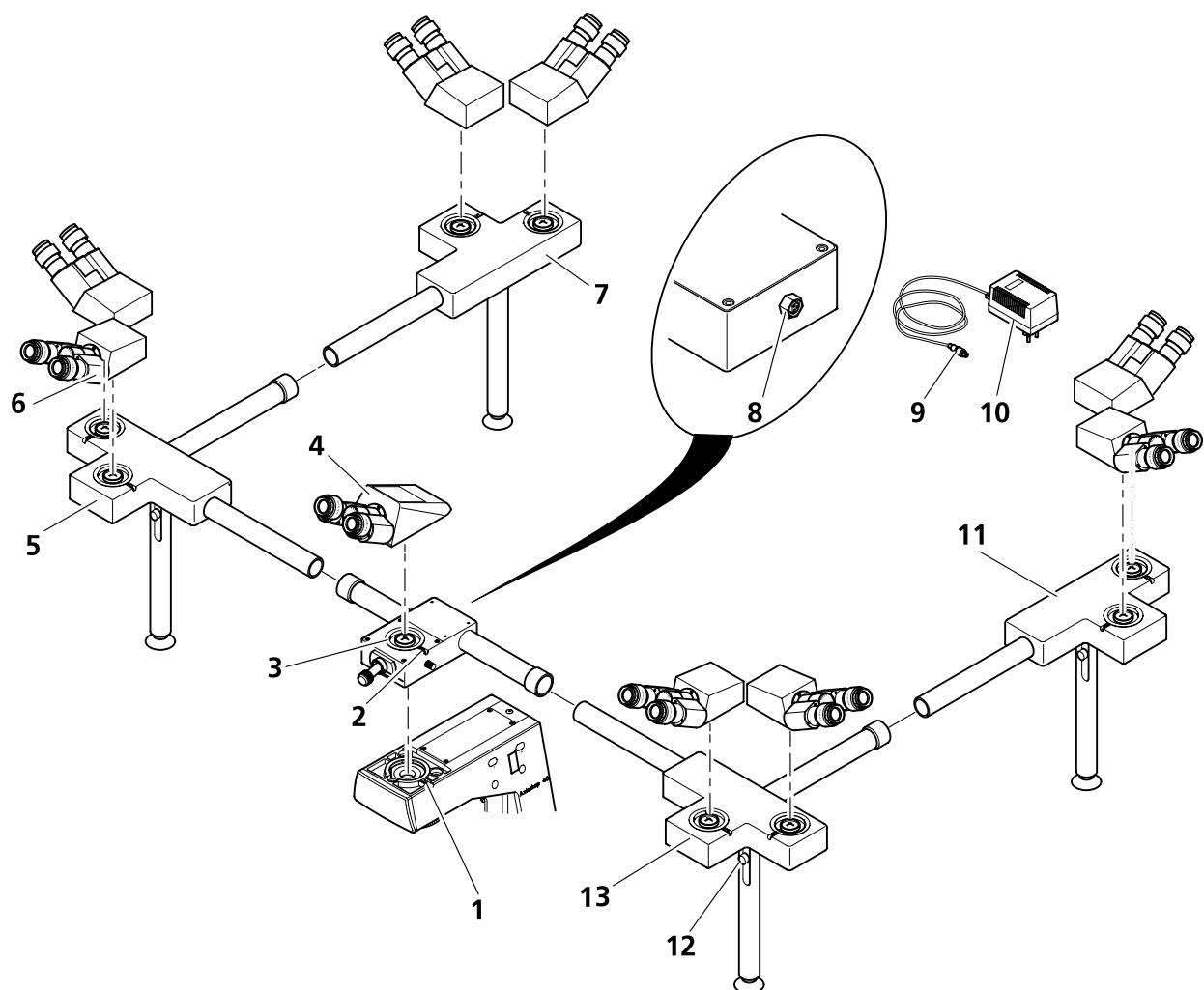
Should you choose to assemble the equipment yourself, please proceed as follows:

- Remove binocular tube and intermediate tube (if provided) from the stand (also refer to Section 2.2.10).
- Insert the base unit of the multi-observation equipment into the stand opening and tighten with clamping screw (2-48/1).

! Prior to attachment, the tube lens must be removed from the binocular tube (or phototube) for the main user! The D-filter provided must be screwed in instead of the tube lens. This brings the brightness of the image / pointer to the same level as the co-observation tubes.

- Insert the binocular tube or phototube 30°/23 (2-48/4) into the dovetail of the multi-observation equipment (2-48/3), align it and tighten with clamping screw (2-48/2).
- Attach connecting piece L (2-48/5) or end connector L (2-48/7) to the left side of the multi-observation equipment, and connecting piece R (2-48/13) or end connector R (2-48/11) to the right side. Do not forget to remove the protection caps from the tube ends. Each pin must engage in the corresponding opening, then tighten the coupling nuts.
- Attach and clamp two binocular tubes for the multi-observation equipment (2-48/6) on each of the connecting pieces L (2-48/5) and R (2-48/13).
- When mechanically aligning the connecting pieces and end connectors, take care to ensure that field centering, based on the main observer tube (2-48/4), is retained. For this purpose, select a conspicuous specimen area and place it at the point of intersection of the eyepiece reticule (also refer to Section 1.6). After assembly of the first connecting piece, insert the eyepiece with reticule in the respective co-observation tube and, in particular, adjust the height of the connecting tube using the set screw (2-48/12) until the selected specimen area is again positioned at the point of intersection of the eyepiece reticule.
- Attach and tighten a further connecting piece L (2-48/5) or end connector L (2-48/7) to the connecting piece L, and a further connecting piece R (2-48/13) or end connector R (2-48/11) to connecting piece R.
- Attach and clamp two binocular tubes for the multi-observation equipment on each of the end connectors R and L. Perform height adjustment using the eyepiece reticule.
- Insert plug (2-48/9) of power unit (2-48/10, 115 V or 230 V) into the socket (2-48/8) on the multi-observation equipment and tighten the ring to prevent shifting.
- Connect power unit for light pointer (2-48/10) to a power outlet (115 V or 230 V).

The binocular tubes of the multi-observation equipment can be turned and fixed in position as required by the user. The multi-observation equipment with light pointer enables up to 9 observation stations to be set up with sufficient brightness for transmitted-light, bright-field. The weaker light phase and VAREL contrast procedures are also possible with slight restrictions.



1	Clamping screw	6	Co-observation tube	11	End connector R
2	Clamping screw	7	End connector L	12	Set screw
3	Dovetail	8	Socket for power unit	13	Connecting piece R
4	Binocular tube	9	Plug		
5	Connecting piece L	10	Power unit		

Fig. 2-48 Attaching the multi-observation equipment

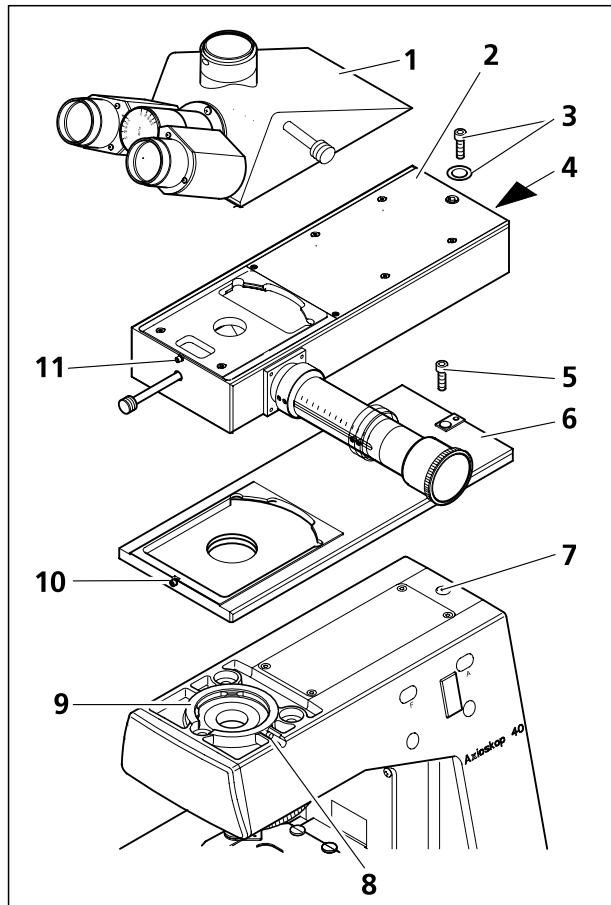


Fig. 2-49 Attaching intermediate tube for image projection

2.2.17 Attaching the intermediate tube for image projection

The intermediate tube for image projection can only be used with the binocular tube from the Axioplan 2 range.

- Use an SW 3 ball-headed screwdriver to undo clamping screw (2-49/8) and remove the tube on the Axioskop 40 / 40 FL upwards.
- Insert the Axioskop connector plate (2-49/6) with the dovetail on the bottom into the stand opening (2-49/9) and slightly tighten clamping screw (2-49/8).
- Insert fastening screw 2-49/5) into the countersunk hole of the connector plate (2-49/6) and screw it into the drilled hole (2-49/7) on the stand.
- Tighten clamping screw (2-49/8) and fastening screw (2-49/5).
- Attach the intermediate tube for image projection (2-49/2) to the stand and tighten clamping screw (2-49/10) only slightly at first. The dovetail is used to help centering.
- Insert the second clamping screw with washer (2-49/3) into the drilled hole provided at the back of the intermediate tube at (2-49/4), screw it into the rear threaded hole of the connector plate and tighten it slightly.

- Align the intermediate tube with the edges of the upper stand and alternately tighten clamping screws (2-49/3) and (2-49/10).
- Use the cover of the tube lens storage case to unscrew the tube lens from the Axioplan 2 tube (2-49/1) and store it in the case.
- Attach Axioplan 2 tube (2-49/1) without tube lens to the intermediate tube, align it with the edges of the intermediate tube and tighten with clamping screw (2-49/11).
- Equip the Axioplan 2 tube (2-49/1) with eyepieces with field number 23.

 The zoom system invariably points to the right. The specimen is positioned on this side below the input opening of the zoom tube.

OPERATION

Table of contents

3	OPERATION.....	3-4
3.1	Axioskop 40 operation and function controls	3-4
3.2	Axioskop 40 FL operation and function controls	3-10
3.3	Operation controls for accessory components	3-16
3.4	Switching Axioskop 40 and Axioskop 40 FL on and off.....	3-20
3.5	Illumination and contrast procedures	3-21
3.5.1	Setting transmitted-light bright field according to KÖHLER	3-21
3.5.2	Setting transmitted-light phase contrast.....	3-24
3.5.3	Setting transmitted-light VAREL contrast.....	3-26
3.5.4	Setting transmitted-light dark field.....	3-27
3.5.5	Setting transmitted-light oblique illumination	3-29
3.5.6	Setting transmitted-light polarization	3-30
3.5.7	Setting epi-fluorescence	3-34
3.6	Documentation	3-36
3.6.1	Attaching photomicrography equipment.....	3-36
3.6.2	Attaching adapters for video cameras	3-40
3.6.3	Attaching adapters for compact digital cameras.....	3-42
3.6.4	Digital cameras with 37 mm filter thread, e.g. SONY DCR-PC100 / SONY DSC-S50.....	3-43
3.6.5	Digital cameras with 52 mm filter thread, e.g. SONY DSC-S70, DSC-S75, DSC-S85.....	3-44
3.6.6	Adapting cameras with different filter thread sizes.....	3-46
3.6.7	Sony DSC-S70, DC-S75, DSC-S85 on digital camera adapter 44 M52x0.75	3-46
3.7	Multiple observer equipment	3-47
3.7.1	Using active co-observation equipment for 2 users	3-47
3.7.2	Using multi-observation equipment.....	3-49
3.8	Drawing device	3-51
3.8.1	Attaching switchable intermediate tube for image projection	3-51
3.9	Measuring lengths.....	3-52

List of illustrations

Fig. 3-1	Axioskop 40 operation and function controls	3-4
Fig. 3-2	Luminous-field diaphragm	3-7
Fig. 3-3	Condenser 0.9/1.25 H	3-7
Fig. 3-4	Mechanical stage with specimen holder	3-8
Fig. 3-5	Nosepiece with openings for compensators	3-8
Fig. 3-6	Specimen marker	3-9
Fig. 3-7	Axioskop 40 FL operation and function controls	3-10
Fig. 3-8	Universal condenser	3-13
Fig. 3-9	Mechanical stage with specimen holder	3-14
Fig. 3-10	Nosepiece with openings for compensators	3-14
Fig. 3-11	Luminous-field diaphragm	3-15
Fig. 3-12	Binocular ergo-phototube	3-16
Fig. 3-13	Ergonomic binocular phototube	3-17
Fig. 3-14	Setting viewing height on the binocular tube	3-17
Fig. 3-15	Overview adapter	3-18
Fig. 3-16	Filter mount	3-18
Fig. 3-17	Turning on the microscope	3-20
Fig. 3-18	Axioskop 40 microscope settings for transmitted-light bright field	3-22
Fig. 3-19	Setting the height stop on the condenser carrier	3-23
Fig. 3-20	Centering phase stop on the universal condenser	3-25
Fig. 3-21	Centering phase stop (light, in the condenser) to the phase ring (dark, in the objective)	3-25
Fig. 3-22	Condenser 0.9/1.25 H and slider with VAREL segment stop	3-26
Fig. 3-23	Centering dark field stop on the universal condenser	3-28
Fig. 3-24	Condenser 0.9/1.25 H and slider with phase stops	3-29
Fig. 3-25	Transmitted-light polarization components on the Axioskop 40 / 40 FL	3-30
Fig. 3-26	Determining the vibration direction n_y' using the example of an artificial fiber	3-31
Fig. 3-27	Diagram of the Michel-Lévy color charts	3-32
Fig. 3-28	Epi-fluorescence components of the Axioskop 40 FL	3-35
Fig. 3-29	Attaching an SLR camera (e.g. Contax 167 ARIA)	3-37
Fig. 3-30	Attaching a microscope camera (e.g. MC 80 DX)	3-38
Fig. 3-31	Attaching the Sony-Kamera "Digital Handycam DCR-PC100"	3-43
Fig. 3-32	Attaching the Sony "Digital Still Camera DSC-S70"	3-44
Fig. 3-33	Implementing active co-observation equipment for two users	3-48
Fig. 3-34	Using multi-observation equipment	3-50
Fig. 3-35	Attaching intermediate tube for image projection from Axioplan 2	3-51
Fig. 3-36	Length measurement using scale 1 on the stage micrometer (object) and scale 2 on the crossline micrometer (eyepiece)	3-53

Axioskop 40
Axioskop 40 FL

OPERATION

Carl Zeiss

3 OPERATION

3.1 Axioskop 40 operation and function controls

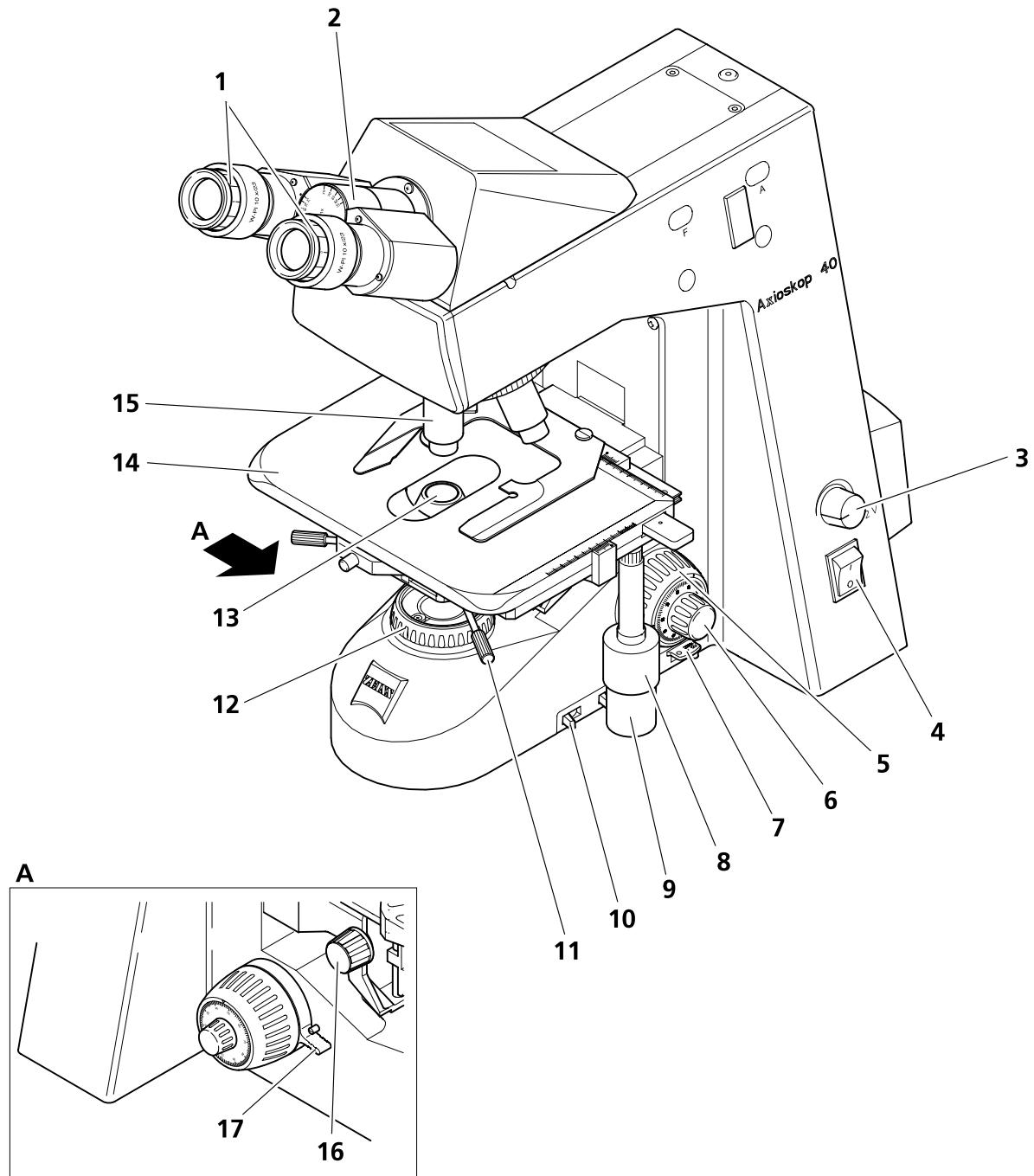


Fig. 3-1 Axioskop 40 operation and function controls

Key to Fig. 3-1:

- 1 Eyepieces
- 2 Binocular tube
- 3 Light intensity regulator
- 4 On / Off switch with integrated control display
- 5 Focusing drive - rough adjustment (on both sides)
- 6 Focusing drive - fine adjustment (on both sides)
- 7 Color temperature key 3200 K at 12V
- 8 Drive knob for movement of the mechanical stage in y direction
- 9 Drive knob for movement of the mechanical stage in x direction
- 10 3 levers to swivel filters in / out in the transmitted-light filter magazine
- 11 Centering screw for universal condenser (on both sides)
- 12 Luminous-field diaphragm
- 13 Condenser 0.9/1.25 H
- 14 Mechanical stage with torque setting and specimen holder
- 15 Nosepiece with objectives
- 16 Drive knob for condenser height adjustment
- 17 Clamping lever for focusing drive height stop

Eyepieces (3-1/1)

- The two eyepiece versions, PL 10x/23 Br. foc. and W-PL 10x/23 Br. foc., enable ametropia of the user's eyes to be compensated (see Section 2.1.3) and also eyepiece reticules to be accepted (see Section 1.6).

Binocular tubes (3-1/2)

- The binocular tubes offered permit individual setting of the interpupillary distance and the viewing height by swivelling the eyepiece supports (see also section 2.1.5) within set limits. Furthermore, the two ergonomic binocular tubes enable the viewing angle to be set individually within a range from 6 to 25° or the viewing height in a range of 50 mm, depending on the model concerned.

Light intensity regulator (3-1/3)

- Regulates the voltage supply for the halogen illuminator in the range from approx. 3 to 12 V.

On / Off switch with control display (3-1/4)

- Position 0 = Instrument turned off.
- Position I = Instrument turned on, display glows green when the instrument is turned on.

Focusing drive - rough adjustment (rough drive) (3-1/5)

- Focusing drive for rough adjustment available on both sides of the instrument:
- 1 rough rotation = approx. 5 mm
- Overall lift: approx. 24 mm

Focusing drive - fine adjustment (fine drive) (3-1/6)

- Focusing drive for fine adjustment available on either side of the instrument:
- 1 fine rotation = 0.1 rough rotation

Color temperature key 3200 K (3-1/7) (3-1/7)

- With the conversion filter switched on and **full** lamp voltage (12 V), the color temperature comes to 3200 K. This is required for photomicrography using color films (artificial light).
- Lever in front position: conversion filter swiveled out
- Lever in back position: conversion filter swiveled in

Drive knob for movement of the mechanical stage in the y direction (3-1/8)

- Movement of the mechanical stage in the y-direction, maximum travel range: 50 mm
- Adjustable torque (smoothness)

Drive knob for movement of the mechanical stage in the x direction (3-1/9)

- Movement of the mechanical stage in the x direction, maximum travel range: 75 mm
- Adjustable torque (smoothness)

Travel range adjustment for the mechanical stage with torque

- Distance adjustment of the mechanical stage, maximum adjustment range 15 mm

3 levers to swivel filter in / out in the transmitted-light filter magazine (3-1/10)

- 3 switchable neutral filters to adjust image brightness in the field of view, maximum attenuation factor: 1:4400;
Lever corresponds to (on the stand from front to back): 1.5 %, 6 % and 25 % transmission
- lever in the front position: filter swiveled out
- lever in the back position: filter swiveled in

Centering screw for condenser (3-1/11)

- Centering screws for condenser centering attached on either side of the condenser carrier.

Luminous field diaphragm (3-1/12)

- Wheel (3-2/2) for infinitely variable setting of the luminous-field diaphragm (transmitted light).
- Additional mount (3-2/1) for filters with diameter $d = 32$ mm.

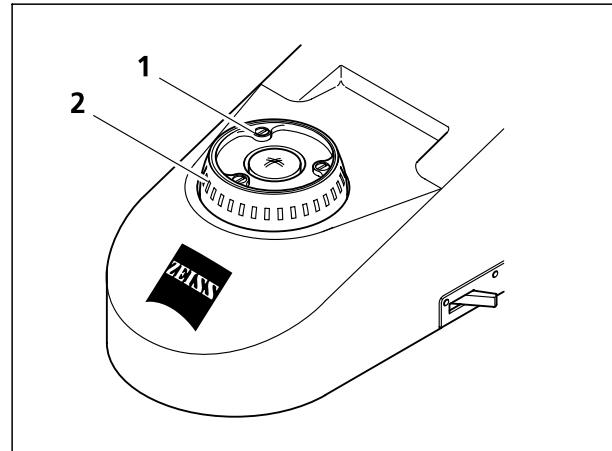


Fig. 3-2 Luminous-field diaphragm

Condenser 0,9/1,25 H (3-1/13)

The Abbe condenser (3-3/1) with aperture diaphragm (3-3/4) can be equipped optionally with:

Slider (3-3/2) for:
bright field (middle stop position)
phase contrast Ph 1, Ph 2, Ph 3 or VAREL contrast
Var1, Var2 (2 installation positions in right and left
stop position) as well as
oblique illumination (2 weaker stop positions).

The bright field position is also equipped with the enclosed neutral filter (25 % transmission) for compensating brightness differences between contrast procedures.

The phase and VAREL segment stops can be centered with 2 knurled screws (3-3/3) each.

The Ph 3 stop can also be used as a dark field stop in combination with objectives with a numerical aperture of < 0.5 .

The VAREL segment stops with the corresponding VAREL objectives are appropriate for displaying specimens in relief contrast. They are to be used for thicker, transparent specimens, which are unsuited for phase contrast (with phase stops and objectives).

- Push slider from the right or left into the condenser 0.9/1.25 H opening and set the stop position desired. Open the aperture diaphragm fully in the left and right stop position.

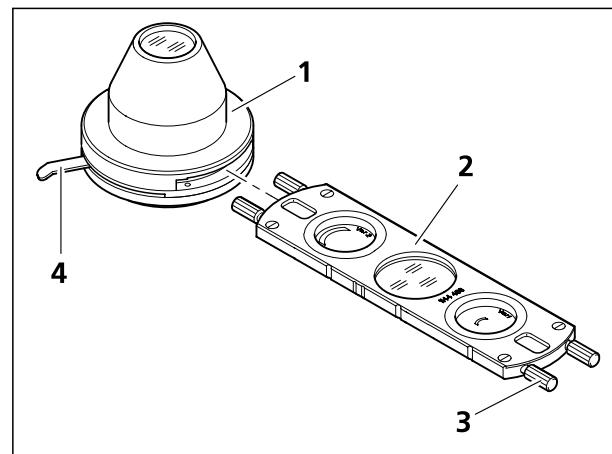


Fig. 3-3 Condenser 0.9/1.25 H

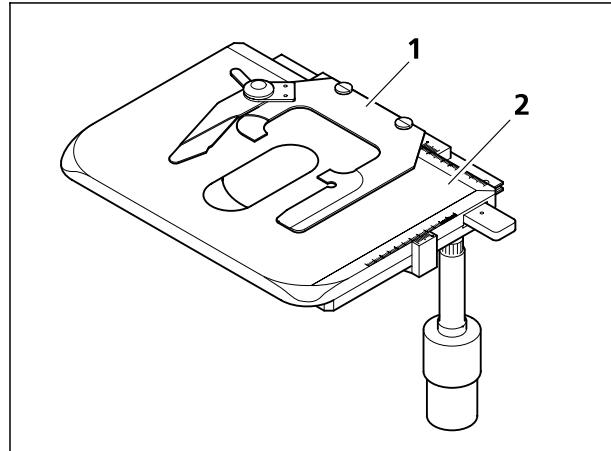


Fig. 3-4 Mechanical stage with specimen holder

Mechanical stage with torque setting and specimen holder (3-1/14)

- Mechanical stage (3-4/2) for placement, positioning and fastening of specimens with the specimen holder (3-4/1).

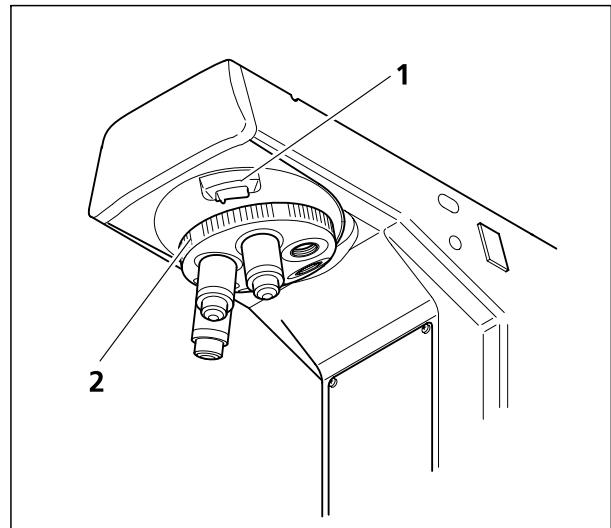


Fig. 3-5 Nosepiece with openings for compensators

Nosepiece with objectives (3-1/15)

- Contains compartment (3-5/1) for compensators.
- W 0.8" thread for six objectives.
- Quick change of objectives by turning the nosepiece with the knurled wheel (3-5/2).

Specimen marker

The specimen marker is screwed into the nosepiece instead of an objective and can be used to mark details of special interest in color on the carrier plate. This enables you to find the marked position more easily.

Three dot or arc markings with a diameter of 5 mm each can be placed on the cover slip.

The red ink adheres well to glass and quickly air dries. However, the ink dissolves when it comes into contact with immersion oil and can be wiped off.

Do not allow the writing surface to become wet or dirty.

- Move specimen detail to the center of the viewing field.
- Remove cover (3-6/4) by pulling it down and swivel specimen marker (3-6/1) into the beam path.
- Press specimen marker ring (3-6/2) down. Exert slight pressure until contact with the cover slip generates 3 dots. Additional pressure on the ring triggers rotation of the ink pins (3-6/3), which generates 3 arcs.
- The spring position of the ink pins prevents damage to the cover slip and writing surface.
- To find the marked specimen detail later, it is best to use an overview objective. This aligns the marking symmetrically to the viewing field edge. Then swivel in an objective with greater magnification (up to approx. 40x). The specimen detail will now be in the viewing field range.

 It is recommended to swing the specimen marker out of the beam path after use and to attach the cover if it is not to be used for longer periods.

Drive knob for condenser height adjustment (3-1/16)

- Condenser height adjustment to set KÖHLER illumination.

Clamping lever for focusing drive height stop (3-1/17)

- Adjustable height stop for stage focusing..
- Turn the clamping lever up against the pin stop. Move stage to the highest position with the focusing drive to prevent collisions with the stage or carrier plate. Clamp in position by pressing on the clamping lever.

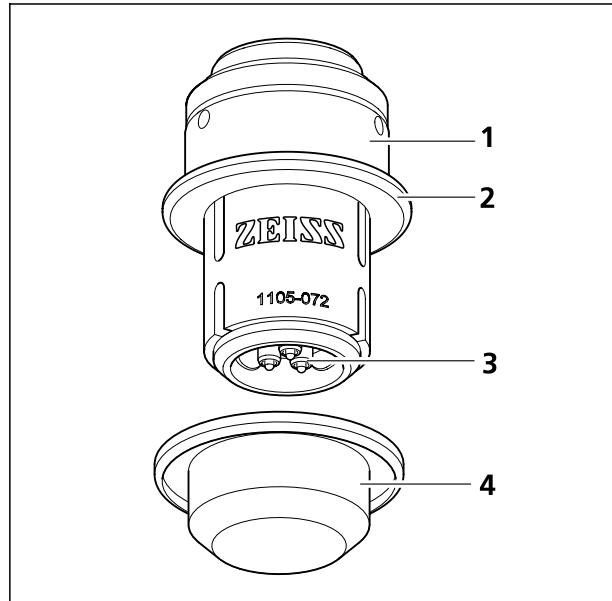


Fig. 3-6 Specimen marker

3.2 Axioskop 40 FL operation and function controls

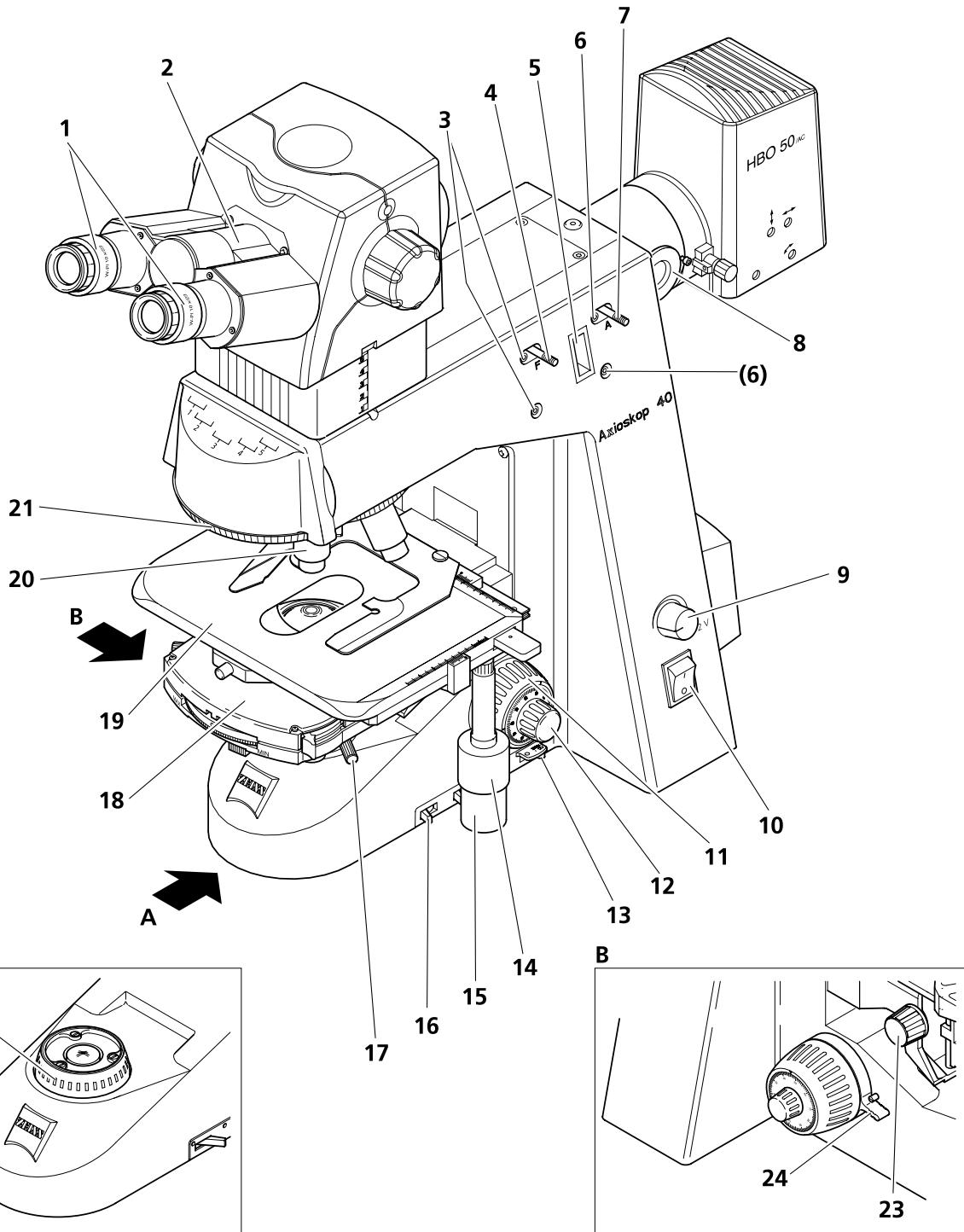


Fig. 3-7 Axioskop 40 FL operation and function controls

Key to Fig. 3-7:

- 1 Eyepieces
- 2 Ergo-tube 20°/23 with height adjustment
- 3 Centering screws for luminous-field diaphragm
- 4 Push rod for luminous-field diaphragm (incident light)
- 5 Compartment for filter slider
- 6 Centering screws for aperture diaphragm
- 7 Push rod for aperture diaphragm (incident light)
- 8 Adjustment guide
- 9 Light intensity regulator
- 10 On / Off switch with integrated control display
- 11 Focusing drive – rough adjustment (either side)
- 12 Focusing drive – fine adjustment (either side)
- 13 Color temperature key 3200 K
- 14 Drive knob for mechanical stage adjustment in the y direction
- 15 Drive knob for mechanical stage adjustment in the x direction
- 16 3 levers to swivel filters in / out in the filter magazine
- 17 Condenser centering screws (either side)
- 18 Universal condenser)
- 19 Mechanical stage with torque setting and specimen holder
- 20 Nosepiece with objectives
- 21 Reflector turret
- 22 Luminous-field diaphragm
- 23 Drive knob for condenser height adjustment
- 24 Clamping lever for focusing drive height stop

Eyepieces (3-7/1)

- See Section 1.6 and 2.1.3.

Binocular tubes (3-7/2)

- See Section 2.1.4 and 2.1.5.

Centering screws for luminous-field diaphragm (incident light) (3-7/3)

- Center the luminous-field diaphragm with an SW 3 ball-headed screwdriver (see also Section 3.5.7).

Push rod for luminous-field diaphragm (incident light) (3-7/4)

- Infinitely variable setting of the luminous-field diaphragm diameter (see also Section 3.5.7).
- Push rod pushed in: fully open
- Push rod pulled out: locked

Compartment for filter slider (3-7/5)

- For 3-position or 6-position filter slider with 18 mm filter diameter.

Centering screws for aperture diaphragm (incident light) (3-7/6)

- Center the aperture diaphragm with an SW 3 ball-headed screwdriver (also see Section 3.5.7).

Push rod for aperture diaphragm (incident light) (3-7/7)

Adjustment guide for lamp adjustment (3-7/8)

- The adjustment guide is used to adjust and center the HBO 100 and HBO 50 fluorescence illuminators

Light intensity regulator (3-7/9)

- Regulates the direct-current voltage supply for the halogen illuminator in the range from approx. 3 to 12 V.

On / Off switch with control display (3-7/10)

- Position 0 = Instrument turned off.
- Position 1 = Instrument turned on, display glows green when the instrument is turned on.

Focusing drive - rough adjustment (rough drive) (3-7/11)

- Focusing drive for rough adjustment available on either side of the instrument:
- 1 rough rotation = approx. 5 mm
- Overall lift: approx. 24 mm

Focusing drive - fine adjustment (fine drive) (3-7/12)

- Focusing drive for fine adjustment available on either side of the instrument:
- 1 fine rotation = 0.1 rough rotation

Color temperature key 3200 K (3-7/13)

- With the conversion filter switched on and full lamp voltage (12 V), the color temperature comes to 3200 K. This is required for photomicrography using color films (artificial light).
- Lever in the front position: conversion filter swiveled out
- Lever in the back position: conversion filter swiveled in

Drive knob for movement of the mechanical stage in the y direction (3-7/14)

- Movement of the mechanical stage in the y direction, maximum travel range: 50 mm
- Adjustable torque (smoothness)

Drive knob for movement of the mechanical stage in x the direction (3-7/15)

- Movement of the mechanical stage in the x direction, maximum travel range: 75 mm
- Adjustable torque (smoothness)

Travel range adjustment

- Distance adjustment of the mechanical stage, maximum adjustment range 15 mm

3 levers to swivel filter in / out in the transmitted-light filter magazine (3-7/16)

- 3 switchable neutral filters to adjust image brightness in the field of view, maximum attenuation factor: 1:4400;
lever corresponds to (on the stand from front to back): 1.5 %, 6 % and 25 % transmission
- lever in the front position: filter swiveled out
- lever in the back position: filter swiveled in

Centering screw for condenser (3-7/17)

- Centering screws for condenser centering attached to either side of the condenser carrier.

Universal condenser (3-7/18)

Depending on the version, the achromatic-aplanatic universal condenser (3-8/1) is equipped as follows:

- fold-out front lens.
- turret disk for:
bright field
dark field - **D**
phase contrast - Ph **1**, Ph **2**, Ph **3**.
- aperture diaphragm (iris stop).

The front lens is folded in / out using lever (3-8/2). Turning the turret wheel (3-8/4) swivels the bright field insert and the contrast stops in the beam path. The abbreviation of the set turret position (e.g. D) is displayed in one of the windows (3-8/5). Slider (3-8/3) opens and closes the aperture diaphragm.

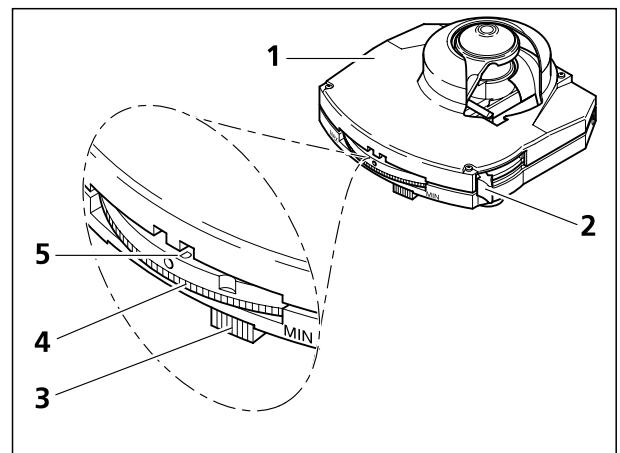


Fig. 3-8 Universal condenser

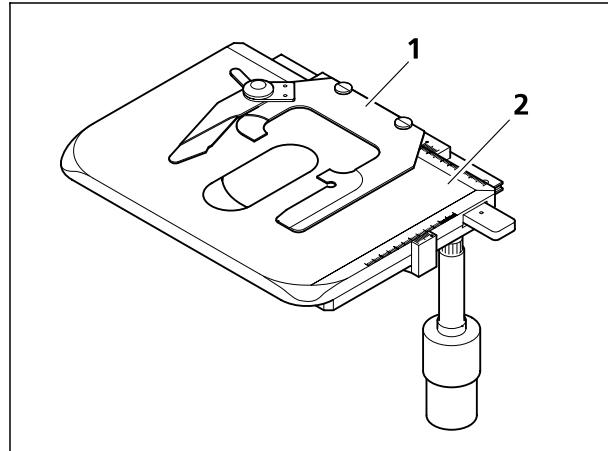


Fig. 3-9 Mechanical stage with specimen holder

Mechanical stage with torque setting and specimen holder (3-7/19)

- Mechanical stage (3-9/2) for placement, positioning and fastening of specimens with the specimen holder (3-9/1).

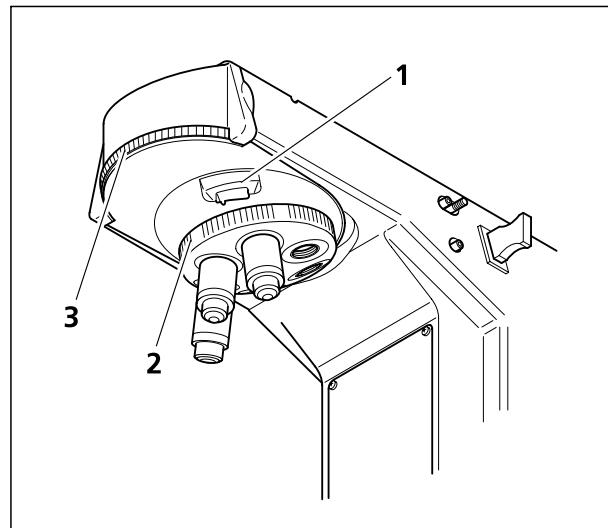


Fig. 3-10 Nosepiece with openings for compensators

Nosepiece with objectives (3-7/20)

See page 3-8.

Reflector turret (3-7/21)

- Accepts a maximum of five reflector modules, such as the FL P&C reflector module and shutter plate for incident light as well as the optovar module and analyzer module for transmitted light.
- Quick change of reflector modules by turning the knurled ring (3-10/3) of the reflector turret.

Specimen marker

See page 3-9.

Luminous-field diaphragm (3-7/22)

See page 3-7.

Drive knob for condenser height adjustment (3-7/23)

- Height adjustment of the condenser to set KÖHLER illumination.

Clamping lever for focusing drive height stop (3-7/24)

- Adjustable height stop for stage focusing..
- Turn clamping lever up against the pin stop. Move stage to the highest position with the focusing drive to prevent collisions with the stage or carrier plate. Clamp in position by pressing on the clamping lever.

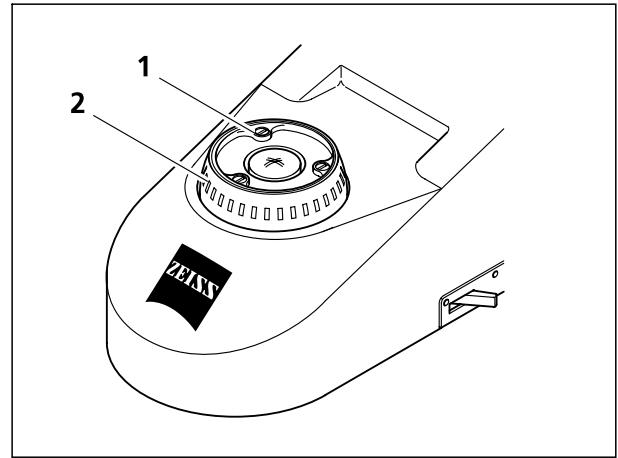


Fig. 3-11 Luminous-field diaphragm

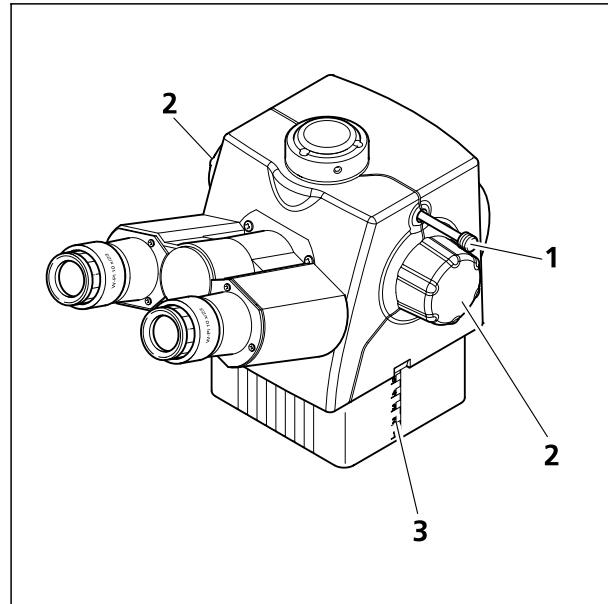


Fig. 3-12 Binocular ergo-phototube

3.3 Operation controls for accessory components

Binocular ergo-tube / ergo-phototube 20°/23

The ergo-tubes are designed for viewing field 23. The viewing angle is 20°.

The two ergo-tubes can be infinitely variably adjusted in a range of 50 mm.

In addition, there is an even greater adjustment range by the binocular component being swiveled from the bottom to the top observation position (depending on interpupillary distance).

In the binocular, you will see a reversed, upside down image of the specimen.

- Use the knobs (3-12/2) to adjust the height.
- Adjustment can be determined by the centimeter interval scale on the side (marked every $\frac{1}{2}$ cm) (3-12/3).

The **ergo-phototube** has two adjustment positions (Distribution: 100:0 / 0:100).

- Push rod (3-12/1) pushed in: 100% to the eyepieces.
- Push rod (3-12/1) pulled out: 100% to the photo port.

The maximum weight allowed on the camera port for camera and cable is 2.5 kg. The Carl Zeiss Service can set a higher maximum load capacity (at a charge) on request.

We recommend placing the ergo-phototube in the lowest position for optimal illumination of the camera image. Light shadows on camera image corners may occur with objectives with large and/or low exit pupils in conjunction with certain camera adapters. The shadows cannot be detected visually. In addition, objective adapter rings should not be used with a camera.

Ergonomic binocular phototube 6-25°/23 (100/100)

The camera port (3-13/1) of the ergonomic binocular phototube enables SLR-cameras, microscope cameras and video cameras to be attached via the corresponding adapters. The light can be directed either to the eyepieces or to the attached camera via a push rod.

An upright, unreversed image of the specimen appears in the binocular.

- Push rod (3-13/2) pushed in:
100 % of the light to the eyepieces
- Push rod (3-13/2) pulled out:
100 % of the light to the camera
- To set the best ergonomic viewing angle, swivel the binocular component (see Fig. 3-13) up or down.
- The interpupillary distance can be changed by separate adjustment of the two eyepiece tubes
- The viewing angle can be changed by swiveling the eyepiece tubes up (3-14/A) or down (3-14/B).

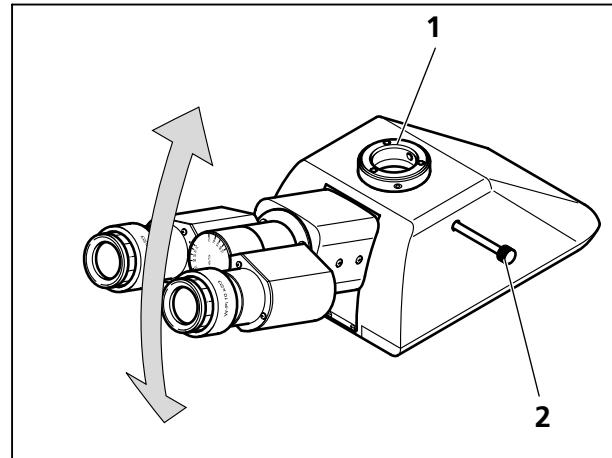


Fig. 3-13 Ergonomic binocular phototube

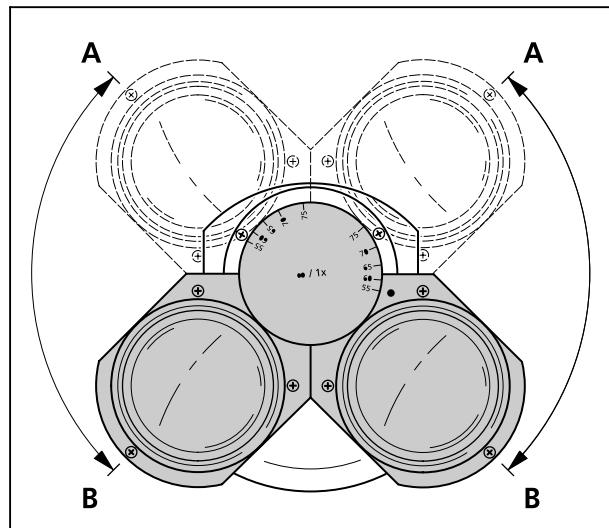


Fig. 3-14 Setting viewing height on the binocular tube

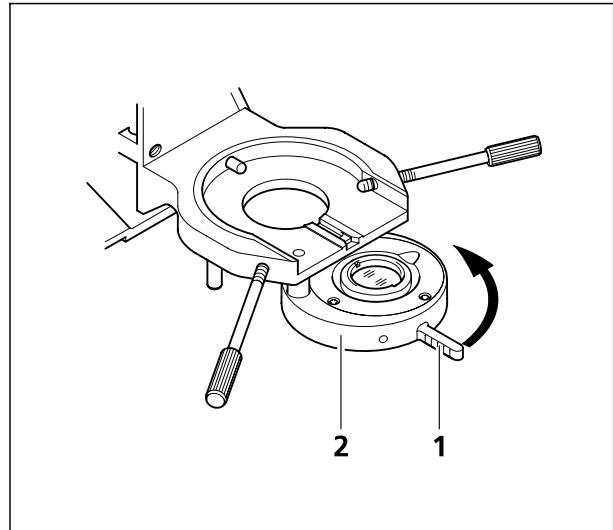


Fig. 3-15 Overview adapter

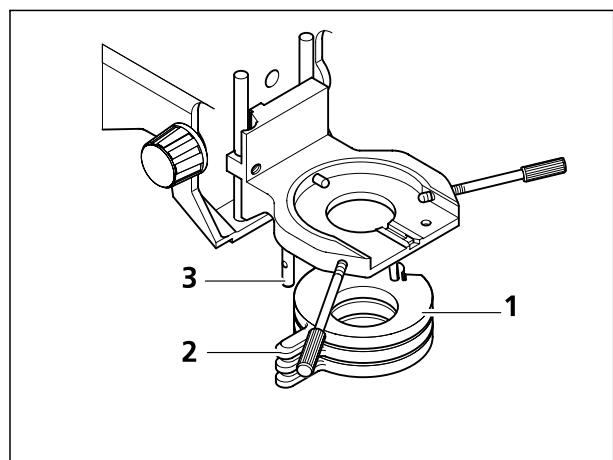


Fig. 3-16 Filter mount

Overview adapter 2.5x-4x

The overview adapter makes for complete image field illumination when a low magnification objective is used (2.5x-4x) combined with the 0.9/1.25 H condenser (000000-1104-285).

The adapter can be centered, remaining in the beam path while the objective is being inserted.

- Swivel overview adapter (3-15/2) into or out of the beam path with the handle (3-15/1). Take sure that the overview adapter engages correctly.

Filter mount

The filter mount enables three 32mm diameter color filters to be swiveled into the beam path jointly or separately.

- Insert filter into one of the three filter plates (3-16/1).
- Swivel the filter plate into the beam path using handle (3-16/2) until it engages in locking pin (3-16/3).

Transmitted-light filter magazine

The transmitted-light filter magazine is controlled by the 3 levers on the stand (3-1/**10** and 3-7/**16**) and can accommodate 3 swivel-in neutral-density filters for attenuation of image brightness in the field of view. Each of these 3 neutral-density filters features graded transmission values of 1.5 %, 6 % and 25 % (viewed on the stand from front to back), thus permitting the maximum attenuation factor of 1:4400 when used individually or combined.

When several filters are combined, the transmission value is calculated as a percentage of the product of the individual transmission values.

Filter slider (Axioskop 40 FL only)

The 3-position or 6-position FL filter slider permits 18 mm diameter filters (e.g. PINKEL-type filters) to be directed into the incident-light beam path. The position of the various filters in the beam path is locked via corresponding notches in the filter slider.

The filter sliders can be equipped individually. For this purpose, only the rubber retaining ring must be removed.

Since the 6-position FL filter slider juts to the other side of the stand when pushed through and can be inserted from either side, the cover attached to the left of the stand must be exchanged for a special guiding piece, which is supplied together with the 6-position FL filter slider. The cover and guiding piece just need to be inserted into the stand opening, which makes them easy to mount.

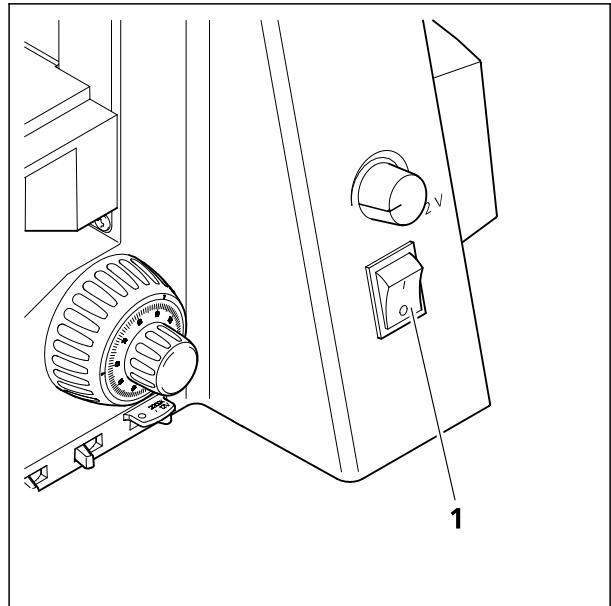


Fig. 3-17 Turning on the microscope

3.4 Switching Axioskop 40 and Axioskop 40 FL on and off

Switching on

- Switch the instrument on with the on / off switch on the side of the instrument (3-17/1).
 - The control display lights up.
- Set the brightness desired using the light intensity regulator.

Switching off

- After you have finished using the instrument, switch it off with the on / off switch on the side of the instrument (3-17/1).
 - The control display is turned off.
- Place the dust cover on the instrument.

3.5 **Illumination and contrast procedures**

3.5.1 **Setting transmitted-light bright field according to KÖHLER**

(1) General principle

Transmitted-light bright field microscopy is the most commonly used of all the optical techniques, since it makes for fast and easy viewing of high-contrast or stained specimens (e.g. blood smears).

For as true-to-object imaging as possible, indirect ray bundles, i.e. ray bundles diffracted and scattered on the specimen details, are of major importance in addition to so-called direct ray bundles. The greater the portion of indirect rays (aperture), the more realistic the microscope image will be, according to ABBE.

To make full use of the entire optical performance of the microscope - especially of the objective, the condenser, the luminous-field diaphragm and the aperture diaphragm should be set in accordance with the rules for KÖHLER illumination. These basic rules of microscope setting are described in detail in Section 3.5.1 (3) "Transmitted-light bright field settings according to KÖHLER on the Axioskop 40 and Axioskop 40 FL".

(2) Transmitted-light bright field equipment on the Axioskop 40 and Axioskop 40 FL

Each Axioskop 40 microscope permits performance of the transmitted-light bright field technique. Either the 0.9/1.25 H condenser or the 0.9 universal condenser can be used.

(3) Setting transmitted-light bright field according to KÖHLER on the Axioskop 40 and Axioskop 40 FL

- The Axioskop 40 has been set up as described in Chapter 2.
- The Axioskop 40 has been switched on.
- Set image brightness via voltage control (3-18/1) on the microscope stand.
- Place a high-contrast specimen on the specimen holder of the mechanical stage.
- Swivel in front lens of universal condenser (for objectives $\geq 10x$) and use drive for height adjustment (3-19/2) to move the condenser to the upper stop. The stop must be set in such a manner that the specimen is not touched by the condenser (for setting of condenser stop, see Section 3.5.1 (4)).
- Depending on the condenser used:
Switch slider (3-19/3) of the 0.9/1.25 H condenser (3-19/4) to the middle position for bright field or the turret disk of the 0.9 universal condenser (if equipped with a turret disk) to position **H** (bright field).

 The 0.9/1.25 H condenser (000000-1104-285) can be used for transmitted-light bright field without the slider.

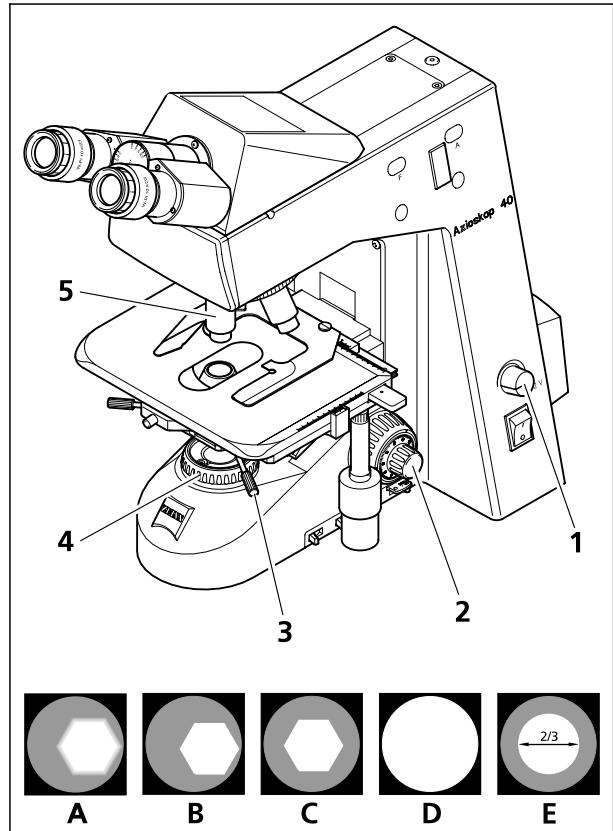


Fig. 3-18 Axioskop 40 microscope settings for transmitted-light bright field

- Swivel in 10x objective (yellow ring, also refer to Chapter 1) into the nosepiece (3-18/5) and focus on the specimen using the drive knob (3-18/2).
- Close luminous-field diaphragm (3-18/4) until it becomes visible (even if not in focus) in the field of view (3-18/A).
- Use drive for height adjustment (3-19/2) to lower the universal condenser until the edge of the luminous-field diaphragm appears in focus (3-18/B).
- Use both centering screws (3-18/3) to center the luminous-field diaphragm image (3-18/C) and then open the diaphragm until its edge just disappears from the field of view (3-18/D).
- For aperture diaphragm setting (contrast), remove one eyepiece from the tube and look through the tube with your naked eye. Use adjusting lever (3-19/5) to set the aperture diaphragm to approx. 2/3 ... 4/5 of the diameter of the objective exit pupils (3-18/E). In most applications, this aperture diaphragm setting provides optimum contrast at almost ideal resolution, and is therefore the best compromise for the human eye.
- Insert eyepiece back in the tube.

 Since specimen field size and objective aperture change after every objective change as does the centering slightly under some circumstances, the settings of the luminous-field diaphragm and aperture diaphragm must be repeated to obtain optimum results.

For < 10x objectives, the front lens of the universal condenser (if used) must be folded out and the aperture diaphragm fully opened. In the case of such large fields, the luminous-field diaphragm can also be used for better contrasting by its opening being reduced by a certain range. Closing it too much should be avoided in order not to worsen the evenness of the field of view illumination.

(4) Setting the height stop on the condenser carrier

- Undo the fastening screw of height stop (3-19/1) using an SW 3 ball-headed screwdriver.
- Use focusing drive to focus on the specimen.
- Close luminous-field diaphragm and focus via the height adjustment control (3-19/2) of the condenser.
- Carefully raise the condenser slightly without lifting the specimen.
- Tighten fastening screw (3-19/1) on the height adjustment.

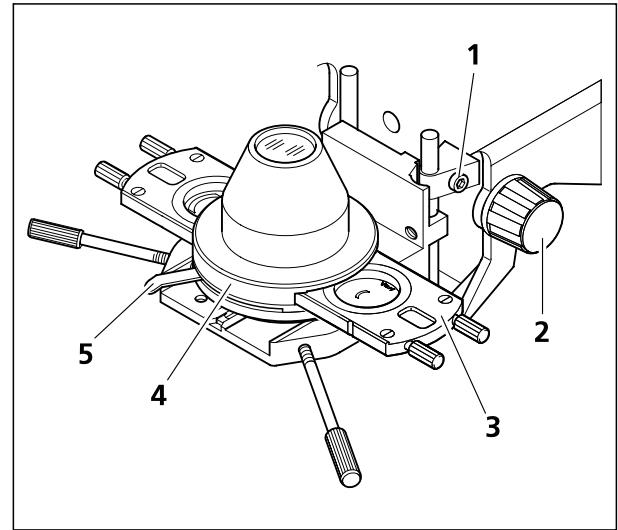


Fig. 3-19 Setting the height stop on the condenser carrier

3.5.2 Setting transmitted-light phase contrast

(1) General principle

The phase contrast technique is ideal for examining thin, unstained specimens, e.g. culture cells. The human eye is unable to see phase differences (differences in refractive index and thickness) between the different cell components.

The phase contrast technique uses the optical modulators "phase stop and phase ring" as well as the interference procedures during formation of the intermediate image in order to change the small phase differences into intensity and color differences that are visible to the eye.

The high-intensity, direct light components are attenuated with the optically defined ring channel "phase stop and phase ring" and given a constant phase shift. The indirect light components diffracted at different cell components, however, bypass this optical channel and are influenced by the in-phase refractive index and the thickness differences in the specimen.

In the intermediate image plane, the partial beams subject to different influence interfere and are enhanced or attenuated - depending on the phase position. This interference results in image contents displaying distinctions in intensity and color that can be perceived by the human eye.

(2) Axioskop 40 and Axioskop 40 FL configurations

- Phase-contrast objectives with phase rings Ph 1, Ph 2 or Ph 3 for different average numerical apertures that can also be used in bright field without restriction.
- Universal condenser with turret disk containing centering phase stops Ph 1, Ph 2 and Ph 3 for different average numerical apertures or 0.9/1.25 H condenser with slider with any combination of a max. 2 phase stops (Ph 1, Ph 2, Ph 3).
- The inserted phase stop on the condenser must match the corresponding label on the objective, e.g. Ph 1.

(3) Setting transmitted-light phase contrast on the Axioskop 40 and Axioskop 40 FL

- Swivel phase-contrast objective, e.g. designated with Ph 1, into the beam path.
- Insert phase stop labeled the same as the phase-contrast objective, e.g. Ph 1, on the turret disk of the universal condenser. When using the 0.9/1.25 H condenser, place slider into the right or left stop position
- To check centering and congruence of the bright phase stop (in the condenser) with the dark phase ring (in the objective), remove one eyepiece from the tube and replace it with the auxiliary microscope. Use the correction device on the auxiliary microscope to focus on the phase stop and the phase ring in the objective exit pupil.
- If congruence is not perfect (3-21/A), use the two SW 1.5 screwdrivers (3-20/1 and 4) on the two centering screws (3-20/2 and 3) to recenter the bright phase stop until complete congruence with the dark phase ring is achieved (3-21/B). With the 0.9/1.25 H condenser, use the knurled screws on the slider for your centering procedure (see Fig. 3-22/1).
- Remove the auxiliary microscope from the tube and re-insert eyepiece in the tube.

Normally, however, centering is not required, since the phase stops are factory-centered and centering is retained even if the universal condenser is removed from the condenser carrier and attached again.

To enhance the image contrast, an interference wide-band filter, green 32 x 4, can be placed on the luminous-field diaphragm or inserted into the filter mount (where available).

Complete phase contrast is only achieved if the bright phase stop (in the condenser) and the dark phase ring (in the objective) are exactly congruent in the illumination beam path (3-21/B).

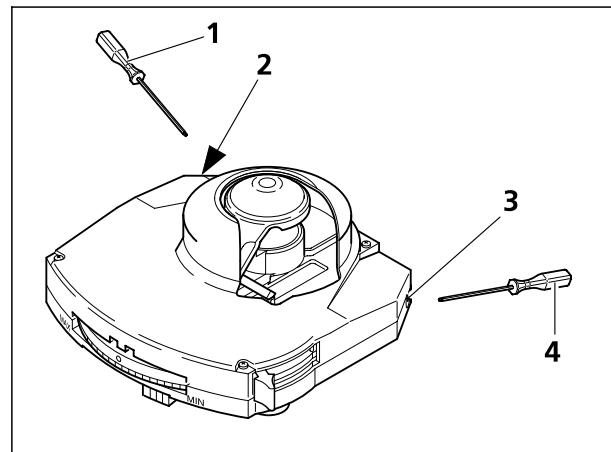


Fig. 3-20 Centering phase stop on the universal condenser

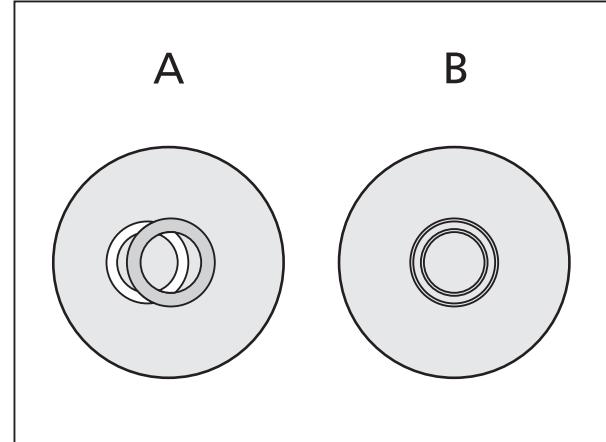


Fig. 3-21 Centering phase stop (light, in the condenser) to the phase ring (dark, in the objective)

3.5.3 Setting transmitted-light VAREL contrast

(1) General principle

VAREL contrast offers a relief-like and rich contrast display of specimen structures.

It can also be used for thick, transparent specimens that cannot be contrasted with phase contrast.

Using the segment-like, high aperture illuminated, absorbing VAREL ring in the objective the intensities of direct and deflected light are balanced. This gives a richer contrast, relief-like image.

(2) Transmitted-light dark field components for Axioskop 40 and Axioskop 40 FL

- 0.9/1.25 H condenser with slider, equipped with VAREL segment stops Var 1 / Var 2
- Objectives suitable for VAREL segment stops: A-Plan 10x/0.25 Ph 1 Var 1 and/or A-Plan 40x/0.65 Ph 2 Var 2.

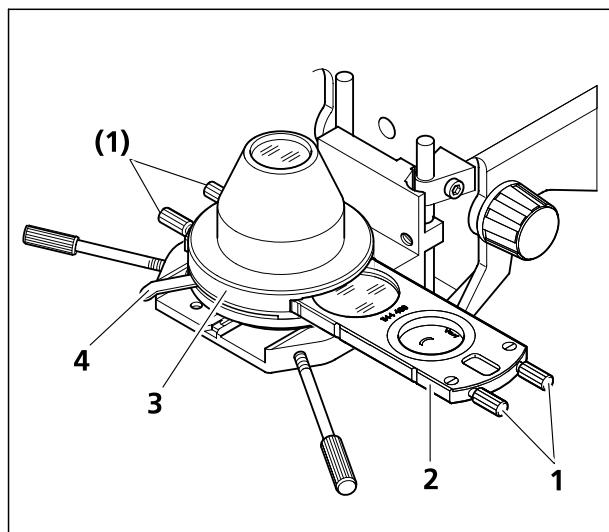


Fig. 3-22 Condenser 0.9/1.25 H and slider with VAREL segment stop

(3) Setting transmitted-light VAREL contrast on the Axioskop 40 and Axioskop 40 FL

- Completely open aperture diaphragm (3-22/4) on the 0.9/1.25 H condenser (3-22/3).
- Move VAREL segment stop into the beam path and guide slider (3-22/2) to the right or left stop position.
- Swivel in appropriate VAREL objective on the nosepiece.
- Where necessary, center the VAREL segment stops by adjusting the knurled screws (3-22/1) in the same manner as for the phase stops (cf. fig. 3-21).

3.5.4 Setting transmitted-light dark field

(1) General principle

Due to their transparency, unstained biological specimens, such as bacteria or living cell cultures, are often barely or not at all visible in transmitted-light bright field. This changes markedly if such specimens are viewed in transmitted-light dark field, where the specimen is illuminated using an aperture that is larger than that of the objective used.

In dark field, only the diffracted and scattered light components, which are important for imaging, reach the objective, while the direct unchanged light bundles are directed past the objective. This is one of the reasons why even fine structures can be resolved, although they are sometimes below the resolving power of the light microscope and appear very bright on a dark background.

(2) Transmitted-light dark field configuration for the Axioskop 40 and Axioskop 40 FL

- Universal condenser with dark field stop in position D and 0.76 to 0.90 aperture on the illumination side
- Use of ICS objectives up to the maximum aperture of 0.65. Objectives with a higher aperture can only be used in conjunction with the above universal condenser if they feature an integrated aperture iris stop.

 The Ph 3 stop of the PH, H and Var slider can be used with the 0.9/1.25 H condenser and objectives < 40x as a dark field stop.

(3) Setting transmitted-light dark field on the Axioskop 40 and Axioskop 40 FL

- Setting KÖHLER illumination is identical to transmitted-light brightfield, except that the highest aperture objective (not oil immersion) must be used instead of the 10x objective.
- Turn the turret disk of the universal condenser to position D and switch in condenser front lens.
- Remove the eyepiece from the tube (replace it with the auxiliary microscope) and check the centering of the dark field stop in the objective exit pupil. If the central dark field stop D in the universal condenser is outside or out of the center of the objective exit pupil, and if the exit pupil is not homogeneously dark, the dark field stop must be recentered.
- To center the dark field stop, use the two SW 1.5 Allen screwdrivers (3-23/1 and 4) and adjust the two centering screws (3-23/2 and 3) until the objective exit pupil is homogeneously dark. After centering, remove both SW 1.5 screwdrivers from the condenser.

 Since the apertures of objectives with an integrated aperture iris stop are too high for transmitted-light dark field, the aperture iris stop must be closed to the limit aperture of 0.65.

As dark a background of the field of view as possible is always the performance criterion for the dark field technique.

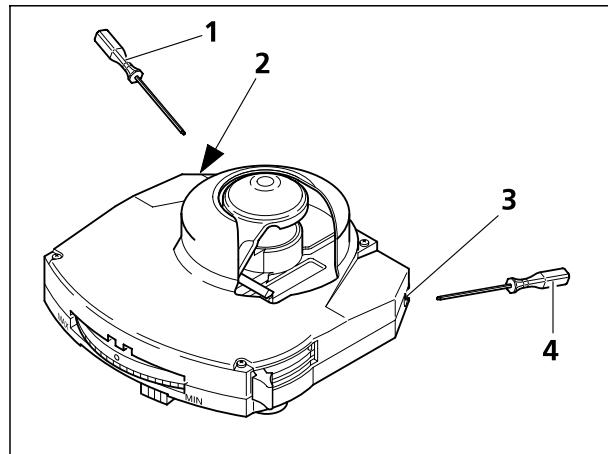


Fig. 3-23 Centering dark field stop on the universal condenser

 Dark field microscopy requires specimens to be considerably cleaner than in other techniques. Fingerprints, dirt or dust particles, in particular, have negative effects, since they brighten the background of the field of view and decrease the contrast of the object image.

3.5.5 Setting transmitted-light oblique illumination

(1) General principle

Oblique illumination offers an additional opportunity to display a relief-like structure of specimens. Oblique illumination allows light into the objective from one side only, which results in a relief-like image.

(2) Axioskop 40 and Axioskop 40 FL configuration for oblique illumination

- 0.9/1.25 H condenser with slider, equipped preferably with phase stops Ph 1 / Ph 2 or Ph 1 / Ph 3 with stop Ph 1 in adjacent slider position to the soft stop notches.

The procedure of oblique illumination would constitute a worsening in comparison with the VAREL contrast therefore the application is not recommended in connection with sliders equipped for VAREL contrast.

(3) Setting oblique illumination on the Axioskop 40 and Axioskop 40 FL

- Place slider (3-24/1) for phase stops on the 0.9/1.25 H condenser (3-24/2) into one of the weaker stop positions (to the side of the middle stop position).
- Open luminous-field diaphragm completely.
- Open aperture diaphragm (3-24/3) completely. With a different slider equipment to the one recommended incident light through an adjacent stop with a larger opening is possible in the weaker stops. In such cases close the aperture diaphragm until you obtain an optimum image.

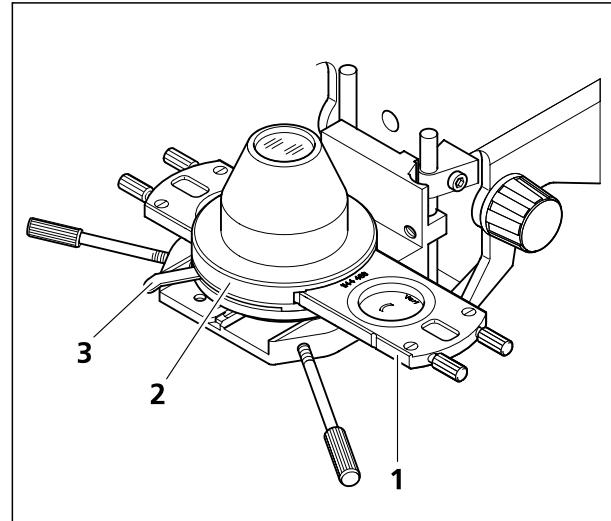


Fig. 3-24 Condenser 0.9/1.25 H and slider with phase stops

3.5.6 Setting transmitted-light polarization

3.5.6.1 Detecting birefringence

(1) Application

The transmitted-light polarization technique is used for specimens that change the polarization condition of light. These are called birefringent, e.g. crystals, minerals or polymers. If these birefringent substances are viewed between crossed polarizers (polarizer \perp analyzer), they are brightened while their surroundings remain dark.

Birefringent substances are recognized by the fact that they feature 4 bright and 4 dark positions between crossed polarizers when turned through 360°. Interference colors ranging from gray (mostly with biological specimens) to white, yellow, red and blue occur as a function of birefringence, thickness and orientation of the specimen. These interference colors can be of the 1st or a higher order.

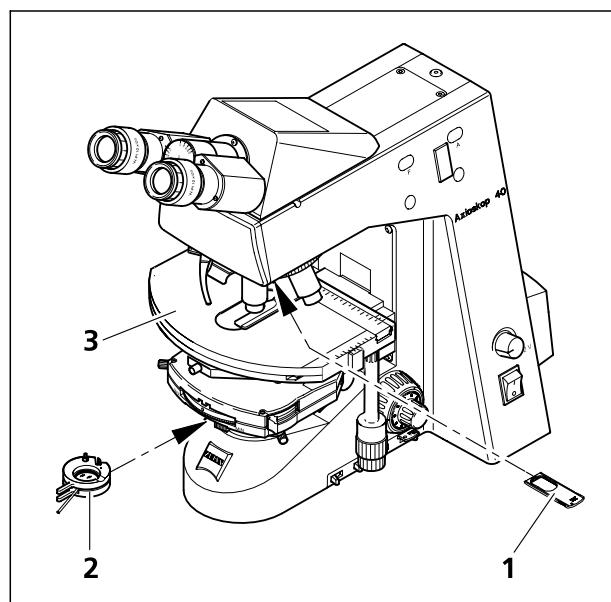


Fig. 3-25 Transmitted-light polarization components on the Axioskop 40 / 40 FL

(2) Axioskop 40 and Axioskop 40 FL configuration

- Objectives suitable for polarization (tension-free)
- Rotary mechanical stage 75x50/240° R
- Polarizer D (rotary or fixed), unless a polarizer is integrated in the condenser
- Analyzer carrier or analyzer module D in the reflector turret (only available with Axioskop 40 L)

(3) Setting Axioskop 40 and Axioskop 40 FL

- Set the microscope as for transmitted-light bright field according to KÖHLER (refer to Section 3.5.1 (3)).
- Center rotary mechanical stage (3-25/3) (refer to Chapter 2).
- Swivel polarizer (3-25/2) into the beam path and position it to 0°, provided that a rotary polarizer is used.

- Insert analyzer carrier (3-25/1) above the nosepiece or swivel in analyzer module on reflector turret (Axioskop 40 FL). The field of view now appears dark on account of the crossed polarizers.

- Bring examination object into the field of view and turn it through 240° with the mechanical stage. Birefringent (anisotropic) specimens now normally display the aforesaid color and intensity changes occurring during rotation between crossed polarizers. However, optically anisotropic substances can also remain dark if an isotropic direction, e.g. of optically uniaxial or biaxial crystals, is oriented parallel to the direction of observation.

3.5.6.2 Determining the vibration direction $n_{\gamma'}$

(1) Application

Determination of vibration directions n_{γ} , $n_{\gamma'}$ (direction with the absolutely or relatively highest refractive index), n_{α} and $n_{\alpha'}$ (direction with the absolutely or relatively lowest refractive index) in relation to morphological directions, e.g. of crystal surfaces, crystal needles or fibers, is an important criterion for recognition. It is also used for the diagnosis of biocrystals (e.g. gout, pseudo-gout).

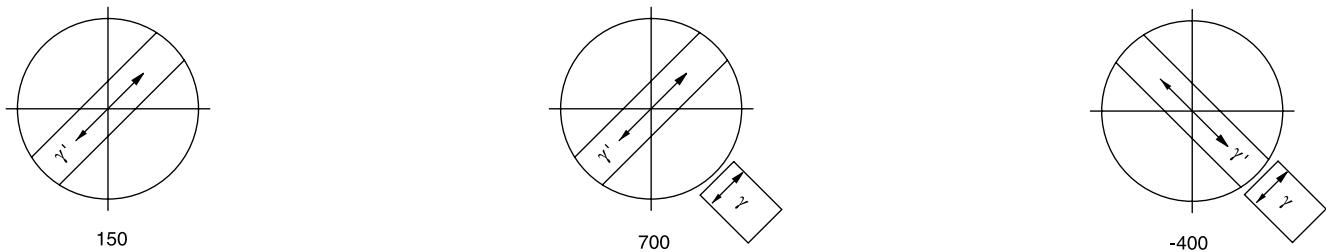


Fig. 3-26 Determining the vibration direction $n_{\gamma'}$ using the example of an artificial fiber

(2) Axioskop 40 and Axioskop 40 FL configuration

- Eyepiece with reticule
- Objectives suitable for polarization (tension-free)
- Rotary mechanical stage 75x50/240° R (3-25/3)
- Polarizer D (rotary or fixed), unless a condenser with integrated polarizer is used.
- Analyzer carrier or analyzer module D in the reflector turret (only available with Axioskop 40 FL)
- Adjusting specimen for polarization microscopy (453679-0000-000)

(3) Setting the Axioskop 40 and Axioskop 40 FL microscopes

- Set the microscope as for transmitted-light bright field (refer to Section 3.5.1 (3)), taking care to ensure that the interpupillary distance of the binocular tube has been set correctly (refer to Section 2.1.3).
- Center the rotary mechanical stage (3-25/3) (refer to Section 2.2.9 (2)).
- Swivel polarizer (3-25/2) into the beam path and position it to 0° , provided that a rotary polarizer is used.
- Swivel in the analyzer module on reflector turret (3-25/1). The field of view now appears dark on account of the crossed polarizers.
- Place Pol adjusting specimen on the microscope stage and turn the stage until the adjusting specimen is in the dark position.
- Switch off analyzer and align crosslines with the fissures of the specimen.
- Then switch on the analyzer again and remove the adjusting specimen. The transmission directions of the polarizer and analyzer are now parallel to the crosslines (polarizer EW, analyzer NS).
- Turn the mechanical stage with specimen, e.g. an artificial fiber, until the specimen displays maximum darkness. The fiber is now parallel to one of the two directions of the crosslines. If pronounced deviations (5° and more) occur, a polarization microscope must be used.

 Do not change the interpupillary distance of the binocular tube now, since otherwise the angle position of the crosslines with reference to the fiber will be changed.

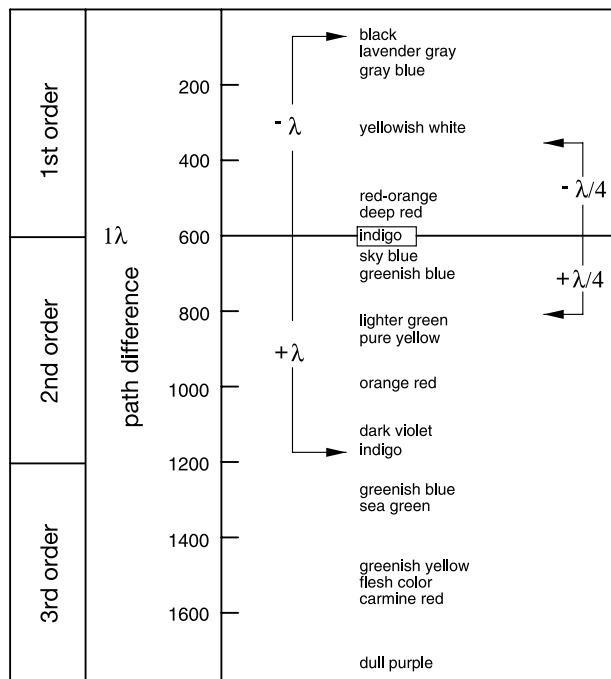


Fig. 3-27 Diagram of the Michel-Lévy color charts

- Turn the stage by approximately 45° until the longitudinal axis of the fiber is oriented in a NE-SW direction (3-26). The specimen now features optimum brightness (diagonal position). In this position, the specimen may display any color.
- Push in compensator λ (only in Axioskop 40 FL because the opening is otherwise occupied by the analyzer slider).

Like the specimen, compensator λ is a birefringent object, though with a defined path difference of 550 nm and the greatest vibration direction n_y defined to be oriented in a NE-SW direction.

The specimen changes its color when compensator λ is pushed in. The type of color change depends on the specimen's orientation (NE-SW or NW-SE).

The changes in color are caused by optical interference. Here, the interference colors (path differences) in both diagonal positions (NE-SW and NW-SE) of the specimen must be compared.

The path difference results from the superimposition (interference) of the vibration direction of the specimen and that of compensator λ .

The greater path difference occurs if the vibration direction of the specimen with the absolutely or relatively highest refractive index (n_y or n_y') is parallel to the greatest vibration direction of compensator λ . The specimen will then appear greenish-blue, for example.

The smallest path difference occurs if the vibration direction of the specimen with the absolutely or relatively lowest refractive index (n_α or n_α') is perpendicular to the vibration direction of compensator λ . The specimen will then appear yellow, for example.

(4) Conclusions

The grayish white color first occurring in the bright position in the above example corresponds to a path difference of 150 nm according to the Michel Lévy color chart (3-27).

The "surroundings" of the artificial fiber, which are not birefringent, appear dark red when compensator λ is inserted, which corresponds to the compensator's path difference of 550 nm (1st order interference color for the path difference 550 nm, corresponds to 1 λ).

If the vibration direction of the birefringent specimen to be examined is parallel to the greatest vibration direction of the compensator λ , i.e. in NE-SW direction, the specimen's path difference (e.g. grayish white: 150 nm) and the path difference of compensator λ (red: 550 nm) add up. This results in a color change to the specimen from grayish white to greenish blue (resulting path difference = 700 nm).

If the vibration direction of the specimen to be examined is perpendicular to the greatest vibration direction of compensator λ , i.e. in NW-SE direction, the specimen's path difference (e.g. grayish white: 150 nm) is subtracted from the path difference of compensator λ (red: 550 nm). A change in the interference color of the specimen from grayish white to orange (resulting path difference = 400 nm) then becomes visible.



Michel Lévy color charts are available under Cat. No. 42-312.

3.5.7 Setting epi-fluorescence

(1) General principle

The epi-fluorescence technique enables high contrast images of fluorescent substances to be displayed in typical fluorescence colors. In the epi-fluorescence microscope, light generated by a high-performance illuminator reaches the excitation filter (band pass) via a heat protection filter. The filtered, short-wave excitation emission is reflected by a dichroic beam splitter and focused on the specimen via the objective. The specimen absorbs the short-wave emission and then emits the long-wave fluorescence (Stoke's law), which is now gathered by the objective and transmitted by the dichroic beam splitter. Finally, the rays pass a barrier filter (long pass/band pass), which only allows the long-wave emission from the specimen to be transmitted.

Excitation and barrier filters, which are both positioned in the FL P&C reflector module together with the corresponding dichroic beam splitter, must be perfectly matched.

(2) Axioskop 40 FL configuration

- Recommended objectives: Plan-Neofluar or Fluar (UV-excitation)
- FL P&C reflector module and shutter plate in the reflector turret
- HBO 103 or HBO 50 mercury vapor short-arc lamp for incident-light illumination
- Fluorescence protection shield

 Before the epi-fluorescence technique is used, it is absolutely essential to adjust the mercury vapor short-arc lamp. If required, re-adjustment must be performed depending on the operation time.

(3) Setting epi-fluorescence on the Axioskop 40 FL

The first epi-fluorescence setting is considerably simplified if the Plan-Neofluar objective 20x/0.50 and a specimen of pronounced fluorescence is used. It is also possible to use demonstration specimens first.

 If compensator λ has not been removed from the compartment above the nosepiece after transmitted-light polarization microscopy, it must be taken out before setting epi-fluorescence.

- Insert the fluorescence protection shield into the compensator compartment above the nosepiece.
- Swivel in Plan-Neofluar 20x/0.50 objective.
- Move the condenser turret to position H, transmitted-light bright field (or phase contrast also), and then move to the specimen area to be examined.
- Keep the light path in the incident-light illuminator blocked at first using the shutter plate on reflector turret (3-28/1) or the barrier position of the incident-light filter slider (3-28/4).

- Switch on the HBO 103 or HBO 50 mercury vapor short-arc lamp (3-28/2) and allow it to warm up to operation temperature for some 15 minutes.
- Select the FL P&C reflector module in the reflector turret (3-28/1) containing the required fluorescence filter combination (depending on excitation) and switch it on.
- When using the incident-light filter slider (3-28/4), unblock the light path in the incident-light illuminator.
- Remove one eyepiece from the tube and set the aperture diaphragm (3-28/3) by opening it until the entire objective exit pupil is unblocked.
- Insert the eyepiece in the tube again and close luminous-field diaphragm (3-28/5) until it is visible in the field of view.
- Use the two centering screws (3-28/6) to center the luminous-field diaphragm in relation to the edge of the field of view.
- Either open the luminous-field diaphragm until it just disappears behind the edge of the field of view or, if there is a risk of specimen bleaching, reduce it until it is visible in the field of view.
- Finally, refocus on the specimen and optimize the HBO 103 collector position as described in Section 2.1.12. Set the collector in such a manner that homogeneous illumination is obtained with the short-wave excitation reflector module. When modules with long-wave excitation are used, correction of the collector position is not required.

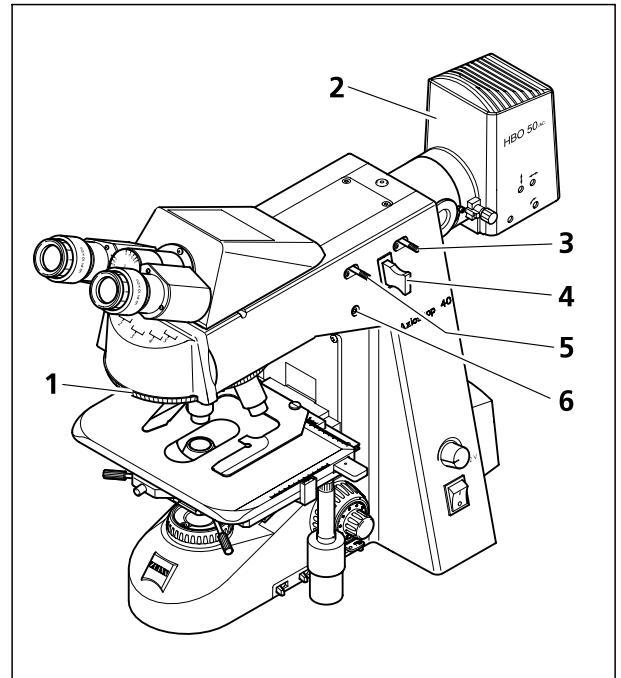


Fig. 3-28 Epi-fluorescence components of the Axioskop 40 FL

3.6 Documentation

3.6.1 Attaching photomicrography equipment

The Axioskop 40 / Axioskop 40 FL microscope equipped with a binocular phototube (3-29/5) can be switched from observation to photomicrography using the push rod (3-29/7) (push rod pulled out).

The special T2 adapter 2.5x and other T2 adapters enable commercially available 35 mm SLR cameras (SLR - single lens reflex) and special microscope cameras (e.g. MC 80 DX or MC 200 CHIP from Carl Zeiss) to be attached to the 60 mm interface camera port of the binocular phototube.

For working with photomicrography equipment, please see the corresponding operating manuals in addition to the information provided here.

Objective adapter rings with neutral filters should only be used for visual brightness compensation, however, not in conjunction with phototubes for photographic purposes.

Depending on film sensitivity, using the neutral filter NG 0.10 may lead to a red cast.

When using the ergonomic binocular phototube 20°/23 with height adjustment (000000-1104-296), the corners of the camera image may darken slightly at higher tube settings.

 Zeiss-Service can accommodate a camera weight greater than 2.5 kg when required.

When using artificial color reversal film, the CB 3 conversion filter generates the correct color temperature of 3200 K. The filter is switched on with the 3200 K color temperature key (3-1/7 and 3-7/13). Lamp voltage must be set to the maximum setting (12 V).

For daylight color reversal film, you must use the CB 12 conversion filter in addition to the CB 3 conversion filter. This filter is placed on the dust protection glass of the luminous-field diaphragm.

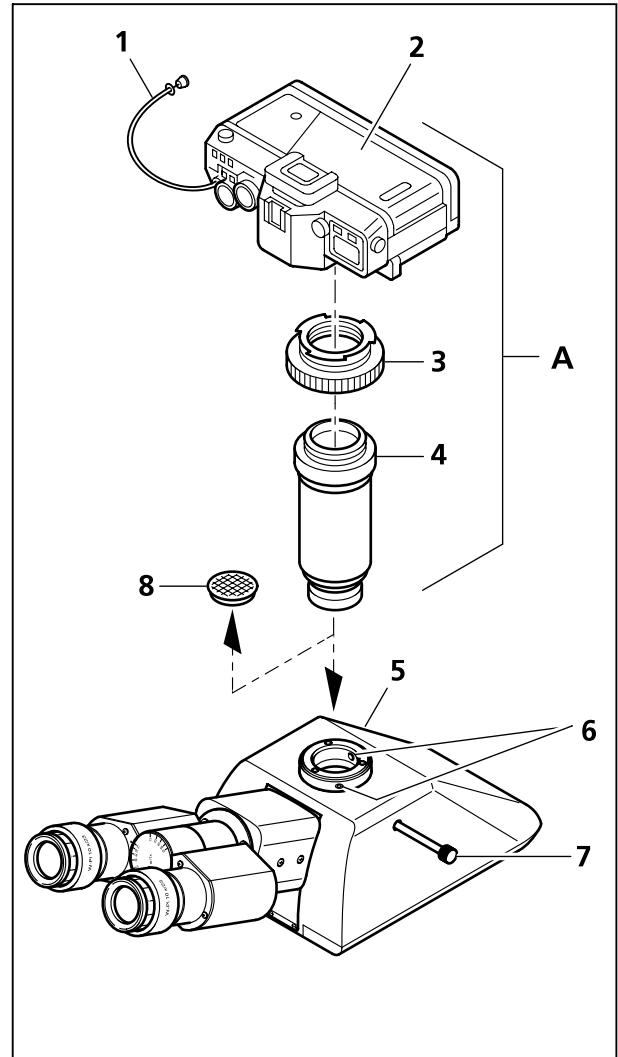
**(1) Attaching an SLR camera,
e.g. CONTAX 167 ARIA**

- Screw T-2 adapter (416010-0000-000, 3-29/3) for the camera used onto the 2.5x connector for T2 (456005-0000-000, 3-29/4).
- Attach camera (416181-0000-000, 3-29/2) and, if necessary, the shutter release cable (416167-0000-000, 3-29/1).
- Remove the dust cap (3-29/8) from the phototube (3-29/5) and insert the pre-assembled unit **A** into the phototube.
- Align the camera unit in the required position and tighten with the three hexagonal screws (3-29/6).
- When artificial light color reversal film is used, the color temperature key 3200 K (3-1/7 3-7/13) must be pressed, and the lamp voltage must be set to maximum.



If focusing is not to be performed through the viewfinder of the camera, a focusing eyepiece with photo reticule MC 2.5x / $d = 26$ mm (454075-0000-000, see p. 1-12) must be used.

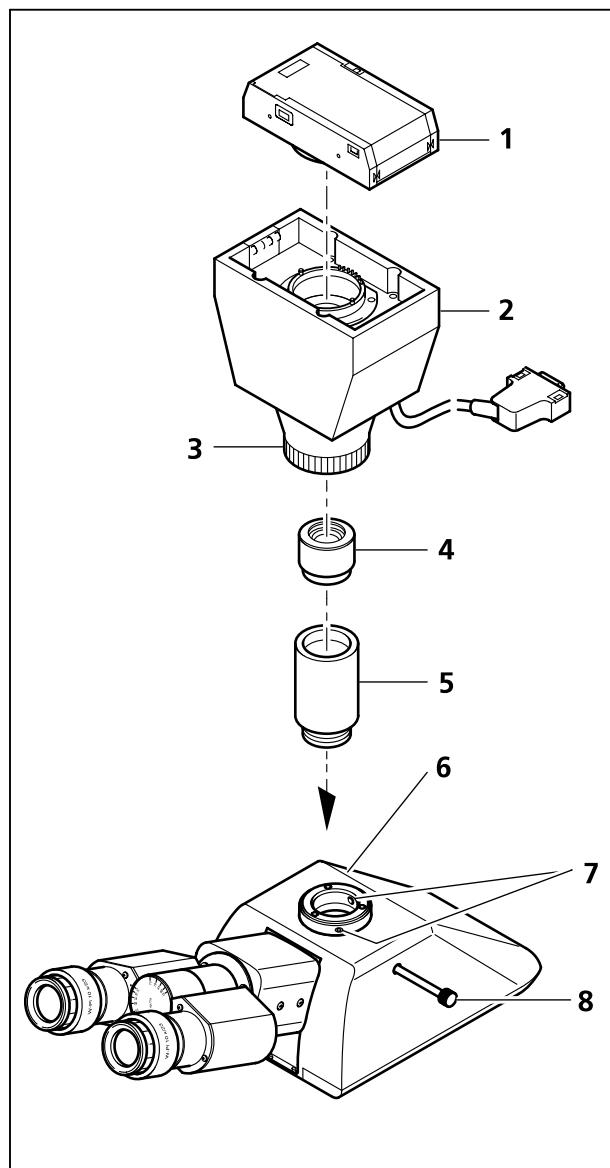
For detailed information on SLR cameras please see manual G 42-406 II, "35 mm SLR cameras for microscopes and stereomicroscopes".



**Fig. 3-29 Attaching an SLR camera
(e.g. Contax 167 ARIA)**

(2) Attaching a microscope camera, e.g. MC 80 DX or MC 200 CHIP, from Carl Zeiss

The Axioskop 40 / Axioskop 40 FL microscope allows not only attachment of SLR cameras, but also of microscope cameras, e.g. MC 80 DX or MC 200 CHIP from Carl Zeiss. You can order the MC 80 DX and MC 200 CHIP microscope cameras directly from Carl Zeiss. You will also need all the other components, for which catalog numbers are given.



- Insert 60 mm interface adapter (456006-0000-000, 3-30/5) into phototube (3-30/6) and tighten three hexagonal screws (3-30/7).
- Insert P 2.5x projection lens (456021-0000-000, 3-30/4) into the microscope camera adapter (3-30/5).
- Attach MC 80 DX basic unit (3-30/2) to the microscope camera adapter as far as it will go, align it and tighten clamping ring (3-30/3) counterclockwise.
- Attach 35 mm Mot DX film cassette (3-30/1) to the basic body in such a manner that the contact pins tightly lodge in the appropriate sockets.
- Use the focusing eyepiece with MC 2.5x / d = 26 mm photo reticule (454075-0000-000, see page 1-12).
- If artificial light color reversal film is used, the color temperature key 3200 K must be set with the lever (3-1/7 and 3-7/13) at maximum lamp voltage.

The microscope camera is operated directly from the console (MC 80 DX) or via a PC / Notebook separately connected to the microscope camera irrespective of the microscope used.

Fig. 3-30 Attaching a microscope camera (e.g. MC 80 DX)

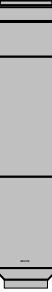
Various T2 adapters for SLR camera housings are listed below:

T2 adapters for SLR camera housings	Cat. No.
T2 adapter for CONTAX (CONTAX bayonet)	416010-0000-000
T2 adapter for OLYMPUS OM (OM bayonet)	416002-0000-000
T2 adapter for MINOLTA (SR bayonet)	416003-0000-000
T2 adapter for CANON (FD bayonet)	416004-0000-000
T2 adapter for NIKON (F bayonet)	416009-0000-000
T2 adapter for PENTAX (KA bayonet)	416011-0000-000

3.6.2 Attaching adapters for video cameras

Thanks to ICS optics from Carl Zeiss, the completely corrected intermediate image falls directly onto the target of the video camera. This makes for optimum quality of the image transfer, even if high-resolution video cameras are used.

The following video adapters with 60 mm interface enable 1-chip b/w and color CCD cameras and 3-chip color/high-resolution CCD cameras to be connected to the phototube of the Axioskop 40 / 40 FL.

Tube	Adapters			Cameras
	 456105-0000-000 60 C 2/3" 1.0X	 000000-1069-414 60 C 2/3" 0.63X	 456106-0000-000 60 C 1/2" 0.5X	
	 456108-0000-000 60 C 1/3" 0.4X	 452989-0000-000 Zoom 44 C 1/3" (3 CCD) 0.35x ... 1.6x		CAMERAS WITH C-MOUNT
		To be used with: 456140-0000-000		
PHOTO- TUBE AXIO- SKOP 40 WITH 60 MM INTERFACE	 456115-0000-000 60 ENG 2/3" 1.0X			3-CHIP- CAMERAS WITH 2/3" BAYONET
	 452984-0000-000 Zoom 44 ENG 1/2" 0.5X ... 2.4X	 452992-0000-000 44 ENG 1/2" 0.63X		3-CHIP- CAMERAS WITH 1/2" BAYONET
	To be used with: 456140-0000-000	To be used with: 456140-0000-000		

The 60 - 44 adapter also allows video adapters with 44 mm interface to be used with the phototube of the Axioskop 40 / 40 FL with 60 mm interface.

Video adapter (Cat. No.)	Suitable for	Comments
 456140-0000-000 Adapter 60 - 44	Microscopes with 60 mm interface and all video adapters for 44 mm interface.	Connects video adapters for 44 mm interface to microscopes with 60 mm interface.

Attachment steps and settings:

- Undo the three hexagonal screws and remove the dust cap from the photo tube.
- Screw the video adapter or video zoom adapter with C-mount thread into the video camera.
- Insert the video adapter or video zoom adapter into ENG 2/3" or ENG 1/2" bayonet of the video camera and clamp it tightly.
- Insert the pre-assembled unit (video camera with video adapter or video zoom adapter) into the photo tube, align it and fasten it using the three hexagonal screws.
- Insert the eyepiece with photo reticule into the binocular tube and align the photo reticule parallel to the camera.
- Pull out the push rod for light path switching completely (100 % light to the camera port).
- Set the required zoom magnification factor via the wheel of the video zoom adapter.
- Where necessary, adjust image brightness on the monitor by changing the lamp brightness on the microscope stand.

3.6.3 Attaching adapters for compact digital cameras

Tube	Adapters	Cameras
PHOTO-TUBE AXIO-SKOP 40 WITH 60 MM INTERFACE	<p>000000-1096-522 D40 M52x0.75 To be used with: 456006-0000-000</p> <p>000000-1108-984 44 M52x0.75 To be used with: 456140-0000-000</p>	COMPACT DIGITAL-CAMERAS / CAMCORDER WITH 37/52 MM FILTER THREAD

3.6.4 Digital cameras with 37 mm filter thread, e.g. SONY DCR-PC100 / SONY DSC-S50

When delivered, the sliding mount with M37 thread (3-31/2) and the lens mount (3-31/4) are pre-assembled. The drawing alongside shows the disassembled components.

- Remove M37/M52 threaded adapter ring (3-32/3).
- Plug connector 60 (3-31/6) onto the binocular phototube (3-31/7) and tighten with the 3 grub screws (3-31/8).
- Screw the unit, consisting of sliding mount with M37 thread (3-31/2) and lens mount (3-31/4), into the M37 filter thread of the camera (3-31/1).
- With the lens mount (3-31/4) pointing forward, plug the unit onto connector 60 (3-31/6) as far as it will go and tighten with the grub screw (3-31/5).

Depending on the microscope configuration and the camera used, the distance between the camera lens and the lens mount (3-31/4) might need to be optimized (see double arrow). This is required, in particular, if an untrimmed image cannot be achieved in any zoom position of the camera lens.

Make the following settings on the camera:

- Switch off the autofocus.
- Set the distance to ∞ .
- Set the exposure control to timed automatic.
- Set the aperture as wide as possible (i.e. select a small f-stop number!).

Not all cameras feature these options. Please refer to the operating instructions of the camera used.

- Undo grub screw (3-31/3).
- Vary the distance between the camera lens and lens mount in stages, i.e. move the sliding mount with the camera on the lens mount by defined steps.

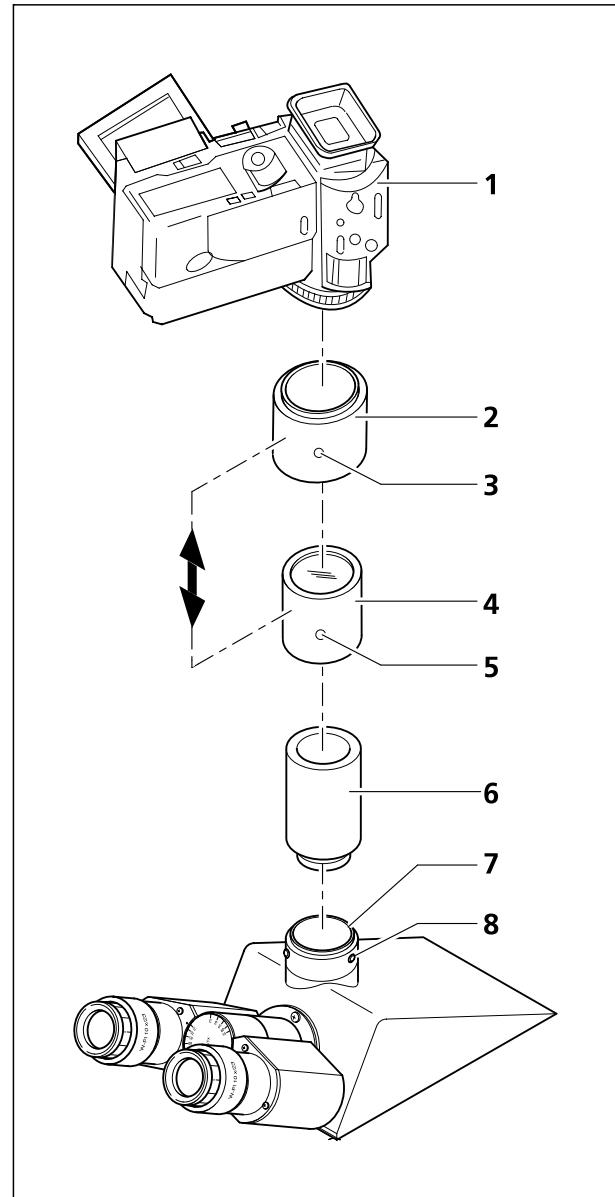


Fig. 3-31 Attaching the Sony-Kamera "Digital Handycam DCR-PC100"

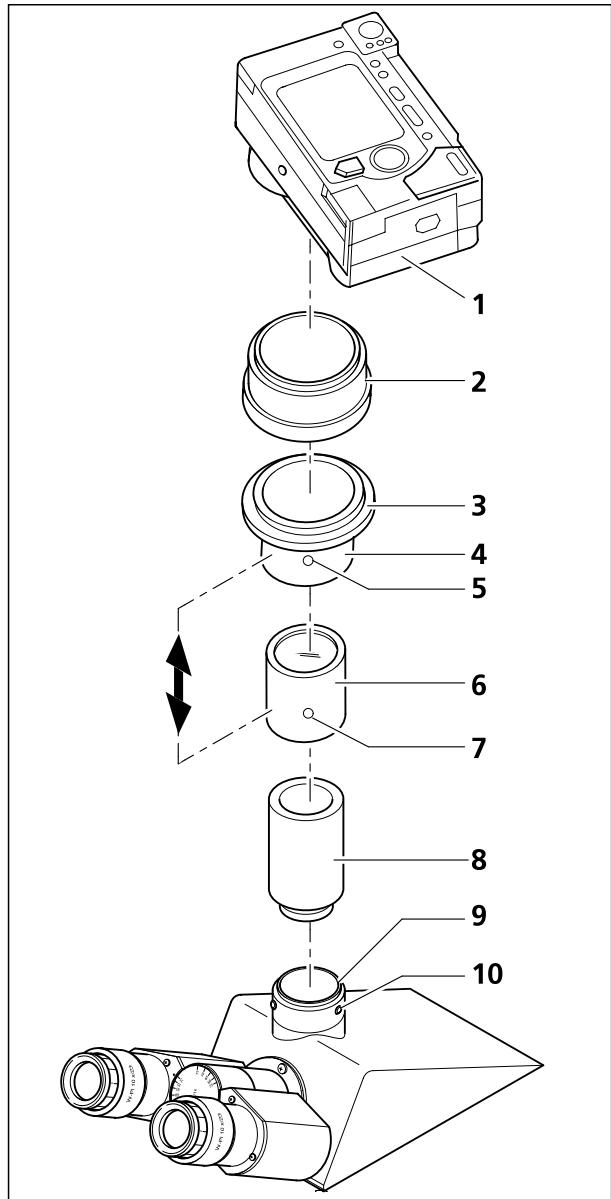


Fig. 3-32 Attaching the Sony "Digital Still Camera DSC-S70"

- Zoom the camera lens from the wide-angle position (W) to the telephoto position (T).
- Perform the test until the image fills the format without trimming or vignetting.
- Tighten grub screw (3-31/3) again.

If you use a camera adapter combination not expressly recommended by Carl Zeiss, it is possible that you will be unable to generate an untrimmed image.

3.6.5 Digital cameras with 52 mm filter thread, e.g. SONY DSC-S70, DSC-S75, DSC-S85

When delivered, the sliding mount (3-32/4), the M37/M52 threaded adapter ring (3-32/3) and lens mount (3-32/6) are pre-assembled. The drawing alongside shows the disassembled components.

Furthermore, the M37/52 threaded ring adapter (3-32/3) can be unscrewed from the sliding mount (3-32/4) (not shown), so that cameras with M37 can also be attached as described in the previous section.

- Screw SONY VAD-S70 adapter ring (3-32/2) into the objective/filter thread of the DSC-S70 camera (3-32/1) as far as it will go.
- Plug connector 60 (3-32/8) onto the binocular phototube (3-32/9) and tighten with the 3 grub screws (3-32/10).
- Screw the unit, consisting of the sliding mount (3-32/4), the M37/M52 threaded adapter ring (3-32/3) and lens mount (3-32/6) into the SONY VAD-S70 adapter ring (3-32/2).
- With the lens mount (3-32/6) pointing forward, plug the unit onto connector 60 (3-32/8) as far as it will go and tighten grub screw (3-32/7).

Depending on the microscope configuration or the camera used, the distance between the camera lens and the lens mount (3-32/6) might need to be optimized (see double arrow). This is required, in particular, if an untrimmed image cannot be achieved in any zoom position of the camera lens.

Make the following settings on the camera:

- Switch off the autofocus.
- Set the distance to ∞ .
- Set the exposure control to timed automatic.
- Set the aperture as wide as possible (i.e. select a small f-stop number!).

Not all cameras feature these options. Please refer to the operating instructions of the camera used.

- Undo grub screw (3-32/5).
- Vary the distance between the camera lens and lens mount in steps, i.e. move the sliding mount with the camera on the lens mount by defined steps.
- Zoom the camera lens from the wide-angle position (W) to the telephoto position (T).
- Perform the test until the image fills the format without trimming or vignetting.
- Tighten grub screw (3-32/5) again.

If you use a camera adapter combination not expressly recommended by Carl Zeiss, it is possible that you will be unable to generate an untrimmed image.

3.6.6 Adapting cameras with different filter thread sizes

Cameras with a filter thread other than M37 or M52 can also be connected with filter adapters or reduction rings available in specialty photo stores. As mentioned above, the compatibility of the cameras and digital adapters can be determined only by testing them.

3.6.7 Sony DSC-S70, DC-S75, DSC-S85 on digital camera adapter 44 M52x0.75

This adapter (000000-1108-984) is designed especially for the Sony DSC-S70 / 75. In conjunction with the Plan objectives, e.g. "Plan-Neofluar", photographs can be generated with increased edge clarity and decreased distortion. Our marketing department will provide information as to whether future cameras will also be suitable for these requirements.

The SONY VAD-S70 adapter ring (3-32/2) must be used to attach the camera. In addition, the 60-44 adapter (456140-0000-000) must be attached between the camera adapter and the binocular tube.

Make the following settings on the camera:

- Turn off the autofocus.
- Set the distance to ∞ .
- Set the exposure control to timed automatic.
- Set the aperture as wide as possible (i.e. select a small f-stop number!).

3.7 **Multiple observer equipment**

3.7.1 **Using active co-observation equipment for 2 users**

The active co-observation equipment is designed for two users and consists of the following:

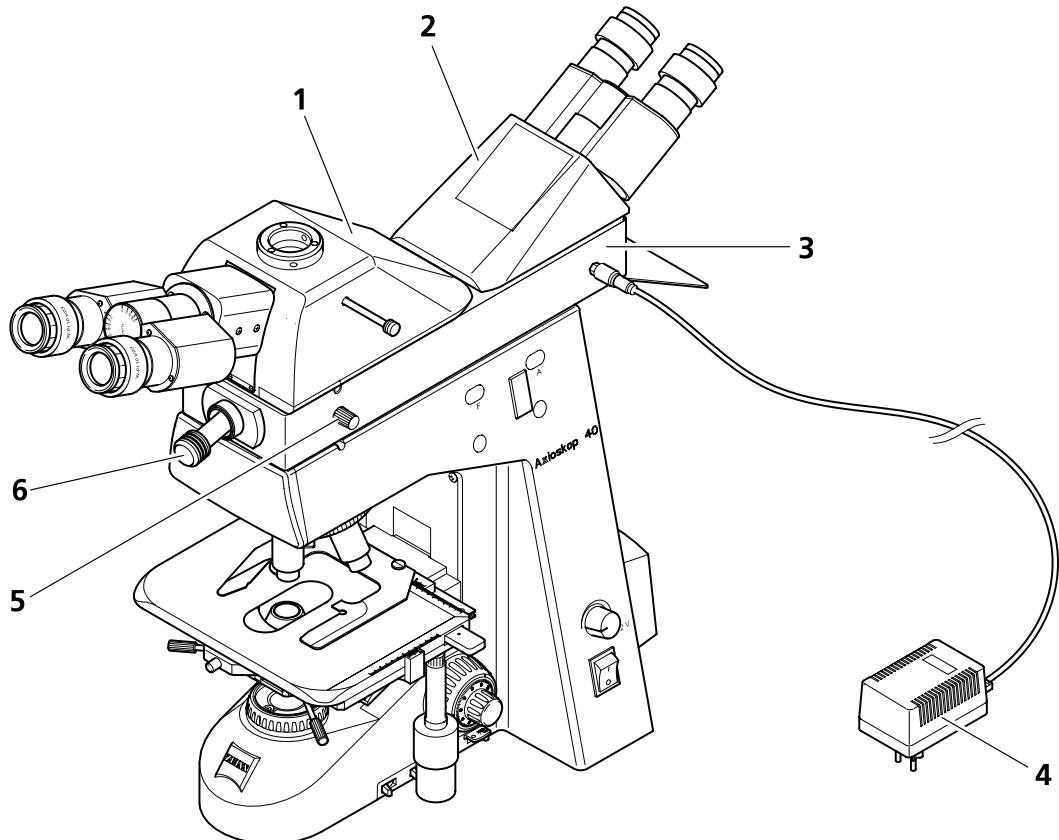
- Basic unit (3-33/3) with two mounts for the binocular tubes
- Power unit (3-33/4) 115 V or 230 V for voltage supply to the light pointer
- Ergonomic binocular phototube 6-25°/23 (3-33/1) for the front tube mount of the microscope
- Binocular tube 30°/23 (3-33/2) or ergonomic binocular phototube 6-25°/23 for the back tube mount of the co-observation equipment.

The ergonomic binocular phototube 6-25°/23 provides an upright, unreversed image in the eyepiece.

 For technical reasons, the epi-fluorescence technique cannot be used combined with the active co-observation equipment.

Operation of the active co-observation equipment is performed via:

- levers (3-33/6) to position the light pointer on the microscope image, which can be operated by both users in the same manner
- adjusting knob (3-33/5) to control the brightness of the light pointer.



- 1 Ergonomic binocular phototube
- 2 Binocular tube
- 3 Basic unit
- 4 Power unit
- 5 Adjusting knob for brightness control
- 6 Lever for light pointer

Fig. 3-33 Implementing active co-observation equipment for two users

3.7.2 Using multi-observation equipment

The multi-observation equipment is designed in such a manner that there is no noticeable loss in optical image quality for a maximum of 9 viewing stations.

The multi-observation equipment consists of the following:

- Basic unit (3-34/2) and two connection tubes for additional viewing stations
- Binocular tube 30°/23 / ergonomic binocular phototube 6-25°/23 (3-34/4, 452340 / 452342)
- Power unit (3-34/9) (100 V to 240 V) for voltage supply to the light pointer
- Connecting piece R (3-34/11, right) and connecting piece L (3-34/5, left)
- End connector R (3-34/10, right) and end connector L (3-34/8, left)
- Binocular tubes 30°/23 for additional viewing stations (3-34/6 and 7, 452927)

 We recommend that you have the multi-observation equipment assembled by Carl Zeiss service staff, since careful optical adjustment and centering of the fields of view of the various observation tubes is required. Should you want to perform assembly yourself, refer to Section 2.2.16, "Attaching the multi-observation equipment".

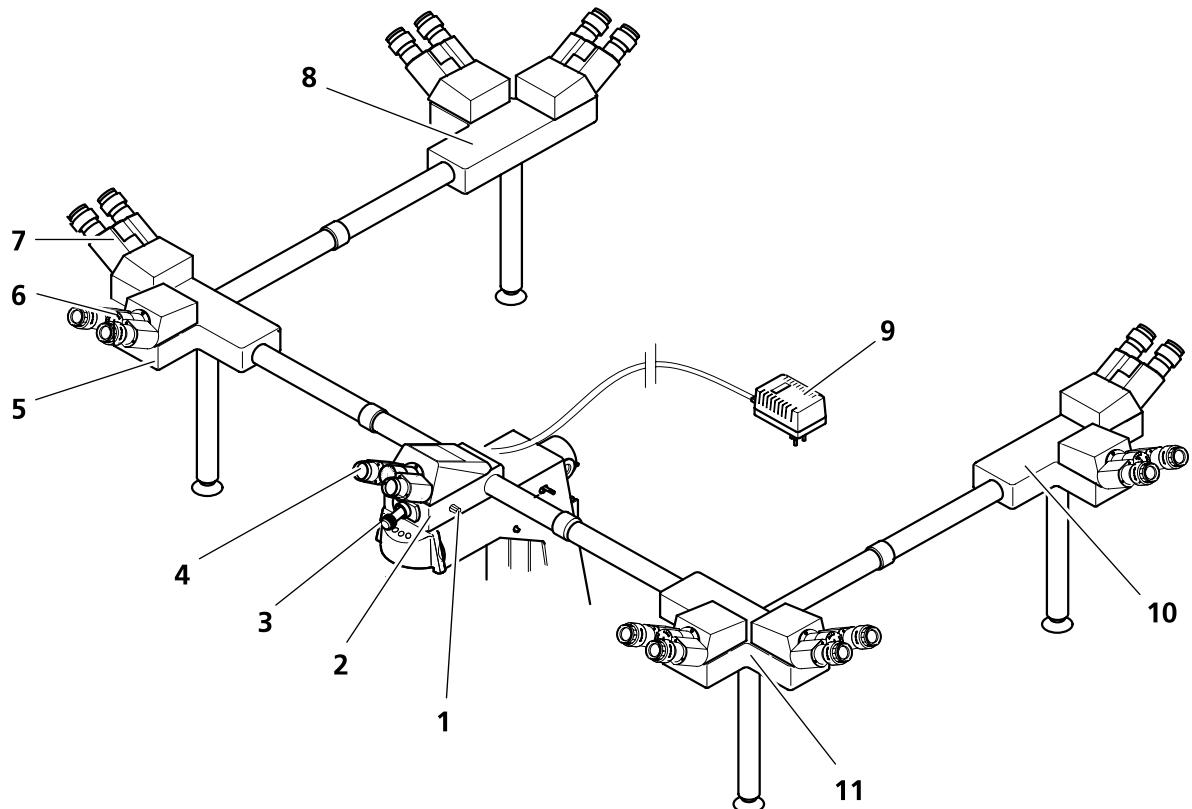
The multi-observation equipment is operated via:

- lever (3-34/3) to position the light pointer in the microscope image
- adjusting knob (3-34/1) to control the brightness of the light pointer

The co-observation tubes can be rotated toward one another and clamped in position in the dovetail mount to achieve as favorable a viewing position as possible. The 90° configuration is not required.

Focus can be corrected via the diopter setting of the foc. eyepieces both on the tube of the Axioskop 40 / 40 FL as well as on all the other co-observation tubes.

 Positioning of the light pointer and its brightness control can be performed on the basic unit of the multi-observation equipment.



1	Adjusting knob for brightness control	7	Co-observation tube
2	Basic unit	8	End connector L
3	Lever for light pointer	9	Power unit
4	Binocular tube	10	End connector R
5	Connecting piece L	11	Connecting piece R
6	Co-observation tube		

Fig. 3-34 Using multi-observation equipment

3.8 Drawing device

3.8.1 Attaching switchable intermediate tube for image projection

The intermediate tube for image projection (3-35/1) can also be attached to the new Axioskop 40 and Axioskop 40 FL routine microscopes via the connector plate (3-35/2). See section 2.2.17 for startup.

The intermediate tube for image projection projects reference material positioned beside the microscope onto the intermediate image of the microscope. This enables the user to copy microscope specimens by drawing.

Furthermore, transparent references, e.g. grain-size plates, reference scales for photomicrography or other self-made patterns with bright lines on a dark background, can be placed on a light box and projected onto the microscope image.

Due to its good imaging performance, the intermediate tube can also be combined with a microscope camera, e.g. MC 200 CHIP from Carl Zeiss, and used for macrophotography. This requires the transmitted light to be switched off.

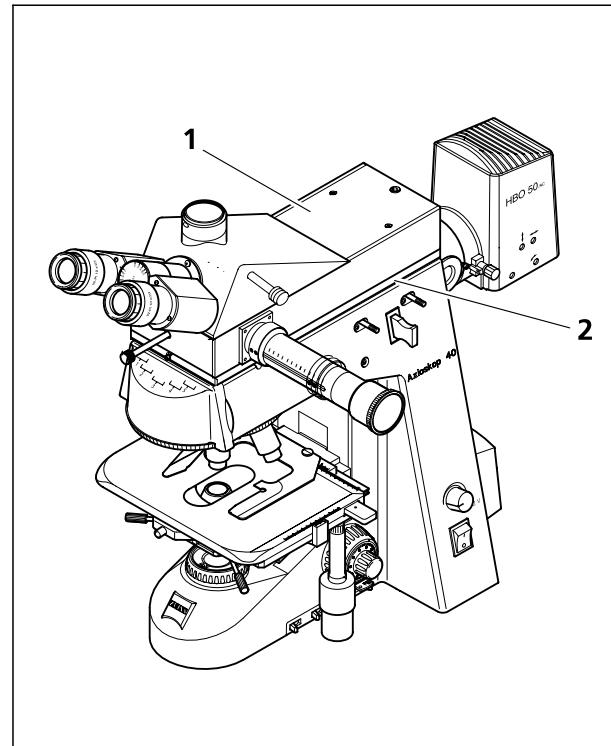


Fig. 3-35 Attaching intermediate tube for image projection from Axioplan 2

3.9 Measuring lengths

Measurement of lengths using the Axioskop 40 / 40 FL requires the following:

- stage micrometer, positive 5 + 100/100 y, D = 0.17 mm as the specimen
- eyepiece crossline micrometer 10:100, d = 26 mm in the eyepiece

An overview of available stage micrometers and eyepiece reticules is available in Chapter 1.

Before length measurement can be performed with the microscope, the micrometer or scale value of the objective / eyepiece reticule combination must be determined. This scale value is exactly that distance in the specimen that corresponds to one interval of the crossline micrometer used.

For calibration, align the scales of the stage micrometer and crossline micrometer parallel to each other by turning the eyepiece, and make the zero line of both scales exactly congruent. If, for example, 99 increments (of 10 µm each) of the stage micrometer correspond to exactly 100 increments of the crossline micrometer, as in Fig. 3-36, the resulting scale value k' for the objective / eyepiece reticule combination used (A-Plan 10x/0.25 and crossline micrometer 10:100) is

$$k' = \frac{99}{100} \times 10 \text{ } \mu\text{m} = 9.9 \text{ } \mu\text{m}$$

 The distance to be measured should be ≥ 5 mm in the eyepiece field to keep the influence of random measuring deviations as low as possible. Other measuring errors may occur if the eyepiece has not been inserted into the tube as far as it will go.

After the stage micrometer has been exchanged for the specimen to be measured, the measuring distance of interest results from the number of increments of the crossline micrometer (tenth estimated), multiplied by the scale value k' . Example:

$$L = 35.5 \times 9.9 \mu\text{m} = 351.5 \mu\text{m}$$

Particularly large sample structures can also be determined by using the vernier scale gradations (0.1 mm) on the mechanical stage. Here, it might be necessary to determine the distance to be measured by calculating a combined x and y measurement (Pythagoras).

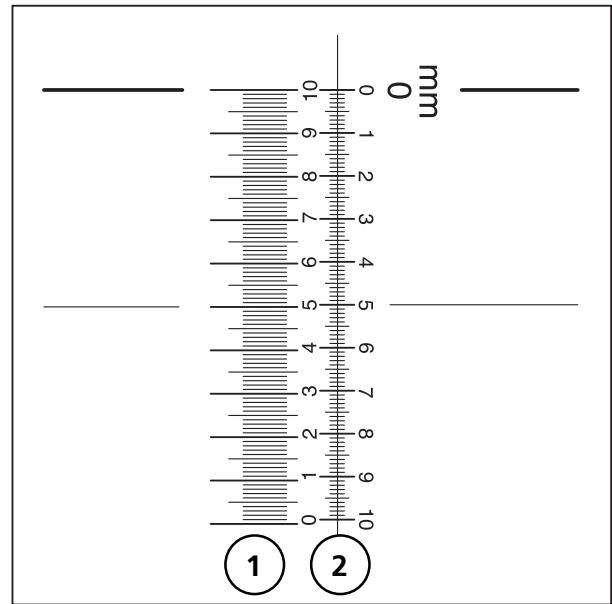


Fig. 3-36 Length measurement using scale 1 on the stage micrometer (object) and scale 2 on the crossline micrometer (eyepiece)

OPERATION

Carl Zeiss

Axioskop 40
Axioskop 40 FL

CARE, MAINTENANCE, TROUBLESHOOTING AND SERVICE

Table of contents

4	CARE, MAINTENANCE, TROUBLESHOOTING AND SERVICE	4-2
4.1	Instrument care	4-2
4.2	Instrument maintenance	4-3
4.2.1	Performing checks	4-3
4.2.2	Changing fuses	4-3
4.3	Troubleshooting	4-4
4.4	Spares, consumables and tools	4-8
4.5	Requesting service	4-9

List of illustrations

Fig. 4-1	Changing fuses	4-3
----------	----------------------	-----

4 CARE, MAINTENANCE, TROUBLESHOOTING AND SERVICE

4.1 Instrument care

Care of the Axioskop 40 / Axioskop 40 FL is limited to the following operations:

- Switch off the instrument each time after use and place the instrument cover on it to protect it from dust and humidity.
- Do not set up the instrument in a humid room; maximum humidity < 85%.
- Cover the open tubes with dust caps.
- Dust and loose dirt on visible optical surfaces should be removed with a brush, bulb, cotton swab, optical paper or cotton cloth.
- Remove water-soluble dirt (coffee, cola, etc.) by blowing on it and wiping it off with a lint-free cotton cloth or a damp cloth. You can use a mild cleaner in the water.
- To remove stubborn, oily dirt, e.g. fingerprints or traces of grease and immersion oil, use a cotton swab or lint-free cotton cloth and the optics cleaning solution L. The cleaning solution comprises 90 Vol% gasoline and 10 Vol% isopropanol (IPA). The individual components are also known as:

Gasoline: Medical alcohol, Petrolether

Isopropanol: 2-Propanol,
Dimethylcarbinol,
2-Hydroxypropan

Clean the optical surface by polishing in circles starting in the middle and moving to the edges (only use slight pressure).

When using the microscope in humid climatic zones, proceed as follows:

- Store the instrument in bright, dry and well-ventilated rooms with humidity not in excess of 85 %; optical components and accessories that are particularly susceptible to fungus growth, e.g. objectives and eyepieces, should be stored in a dry closet.

The risk of fungus growth on opto-mechanical instruments invariably exists in the following conditions:

- Relative humidity in excess of 75 % and temperatures between +15 °C and +35 °C for more than three days.
- Installation in dark rooms without air ventilation.
- Dust deposits and fingerprints on optical surfaces.

4.2 Instrument maintenance

4.2.1 Performing checks

- Take sure to ensure that the instrument complies with the required line voltage (e.g. on the HBO 100 transformer).
- Check the power cable and plug for defects.
- If any damage is visible, switch off the instrument. Have the instrument repaired only by a qualified technician.
- Ensure that the maximum operation time of the halogen and mercury vapor short-arc lamps is not exceeded.

4.2.2 Changing fuses



Always pull the power plug before changing the fuses.

The fuse compartment is on the back of the microscope. It is combined with the instrument socket and contains two **T 1 A/H 250 V** fuses.

- Pull the power plug.
- Pull out fuse holder (4-1/1) until it can be folded down.
- Remove the fuses from the holder upwards and insert new fuses.
- Fold up the fuse holder and push it back into the compartment as far as it will go.
- Insert the power plug in the outlet.

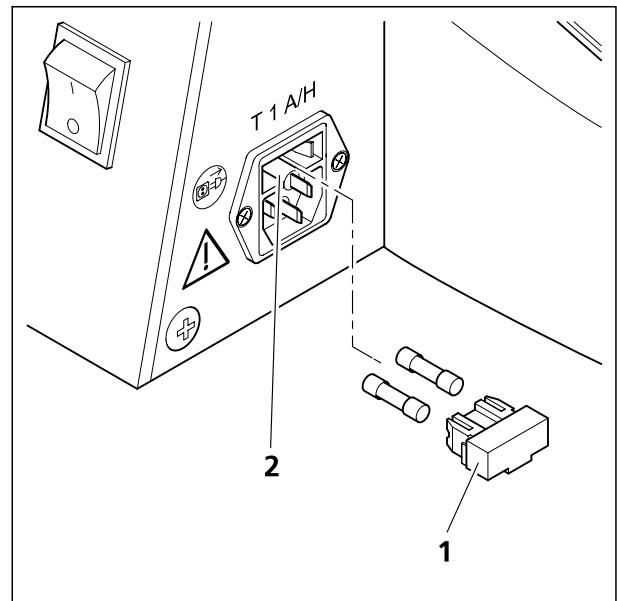


Fig. 4-1 Changing fuses

4.3 Troubleshooting

Problem	Cause	Remedy
	The vis/fot push rod on the camera tube is not in the correct position (intermediate position).	Move the vis/fot push rod on the phototube to the correct position (end position), see Pages 3-16 / 3-17.
	The nosepiece with objective is not in click-stop position.	Switch the nosepiece with objective to click-stop position.
	The condenser is not set correctly.	Set the condenser correctly (adjustment, centering), see P. 3-21 ff.
	The aperture diaphragm is not set correctly.	Set the aperture diaphragm correctly (centering, opening), see P. 3-21 ff.
	The luminous-field diaphragm is not set correctly.	Set the luminous-field diaphragm correctly (centering, opening), see P. 3-21 ff.
	The filter is not inserted correctly in the filter mount.	Insert the filter correctly in the filter mount.

Problem	Cause	Remedy
Low resolving power and poor image contrast.	The aperture diaphragm opening is not set correctly.	Set the aperture diaphragm opening as per the 2/3 rule or the specimen features, see P. 3-22 ff.
	The condenser is not focused correctly and front lens 0.9 not switched correctly.	Focus the condenser and switch front lens 0.9 on or off correctly, see P. 3-22 ff.
	Wrong cover slip thickness for transmitted-light objectives with cover slip thickness 0.17 mm.	Use standardized cover slips with thickness 0.17 mm.
	The carrier plate is incorrectly placed.	Turn over the carrier plate; the specimen side should point up.
	Use of no or non-specified immersion oil with immersion objectives.	Use immersion oil 518 N from Carl Zeiss, see P. 4-8.
	Air bubbles in the immersion oil.	Apply new oil to remove the bubbles.
	Immersion oil on the front lens of a dry objective.	Clean the front lens of the dry objective, see P. 4-2.
	The corr. ring is not set to the correct cover slip thickness.	Set the corr. ring to the correct thickness, see P. 1-8.
	Dirt or dust on the optical surfaces of objectives, eyepieces, condensers or filters.	Clean the appropriate optical components, see P. 4-2.
Asymmetrically blurred images, e.g. one side in focus, one side not in focus.	The condenser is not set correctly.	Set the condenser correctly, see P. 3-22 ff.
	The nosepiece is not in click-stop position.	Correctly click-stop the nosepiece.
	The specimen is not clamped in position on the mechanical stage.	Correctly insert the specimen in the specimen holder and clamp it.

Problem	Cause	Remedy
Greater focus differences after objective change.	The focusing eyepieces are not set correctly.	Set the focusing eyepieces to the appropriate ametropia, s. P. 2-6.
	The objective is not screwed in to the stop position.	Screw in the objective to the stop position.
	The tube lens is either not inserted or inserted superfluously.	Insert the tube lens or remove the superfluous tube lens.
Left and right fields of view cannot be combined to one image.	Interpupillary distance of the binocular tube is not set correctly.	Set the interpupillary distance correctly, see P. 2-7.
	The focusing eyepieces are not set correctly.	Set the focusing eyepieces to the appropriate ametropia, s. P. 2-6.
Eye-fatiguing microscopy.	Interpupillary distance of the binocular tube is not set correctly.	Set the interpupillary distance correctly, see P. 2-7.
	The focusing eyepieces are not set correctly.	Set focusing eyepieces to the appropriate ametropia, s. P. 2-6.
	Image brightness is not acceptable.	Adjust the lamp voltage or insert the conversion filter.
	Binocular tube optically / mechanically out of alignment.	Check / repair by microscopy service.
Dirt or dust in the field of view.	The condenser is not focused correctly and front lens 0.9 not switched correctly.	Focus the condenser and switch front lens 0.9 on or off correctly, see P. 3-22 ff.
	The aperture diaphragm opening is too small.	Set the aperture diaphragm opening as per the 2/3 rule or the specimen features, see P. 3-22 ff.
	Dirt or dust on the optical surfaces of the objectives, eyepieces, condensers, filters or specimens.	Clean the optical surfaces of the affected components, see P. 4-2.

Problem	Cause	Remedy
The 12 V 35 W halogen lamp does not function although the on / off switch is in the "on" position.	The power plug is not connected to the power outlet.	Connect the power plug to the power outlet and be sure to check the instrument and line voltage.
	12 V 35 W halogen lamp is not installed.	Attach 12 V 35 W halogen lamp, see P. 2-12.
	12 V 35 W halogen lamp is defective.	Replace 12 V 35 W halogen lamp, see P. 2-12.
	The specified 12 V 35 W halogen lamp is not used.	Use the specified 12 V 35 W halogen lamp, see P. 4-8.
	The fuses are defective.	Replace fuses, see P. 4-3.
	The electronic module is possibly defective.	Have electronic module checked by service and replaced, if required (see P. 4-9).
The 12 V 35 W halogen lamp flickers; the illumination intensity is unstable.	The power outlet does not provide voltage.	Use a different power outlet.
	End of average service life of 12 V 35 W halogen lamp.	Replace the 12 V 35 W halogen lamp, see P. 2-12.
	Incorrectly installed or broken power cable.	Connect the power cable correctly or replace it.
	The pins of the 12 V 35 W halogen lamp are not correctly inserted into the receptacle.	Correctly insert the pins of 12 V 35 W halogen lamp in the receptacle, see P. 2-12.

4.4 Spares, consumables and tools

Description	Cat. No.	Application
12 V 35 W halogen lamp	000000-0425-360	for transmitted-light illumination
HBO 50AC mercury vapor short-arc lamp	381619-0000-000	for HBO 50 lamp
HBO 103 W/2 mercury vapor short-arc lamp	380301-9350-000	for HBO 103 lamp
SW 3 ball-headed screwdriver	000000-0069-551	to change tubes and lamps
SW 2.5 ball-headed screwdriver		to change FL P&C reflector modules
Eyepiece eyecup	444801-0000-00	recommended for low-brightness techniques to suppress reflected light (not so suitable for eyeglass wearers, where necessary, fold over eyecup)
Dust cover for nosepiece Dust cover for eyepiece tube	462981-0000-000 000000-0168-373	to close unused instrument openings
518 N immersion oil; 20 ml oiler 100 ml bottle 250 ml bottle 500 ml bottle	000000-1111-800 000000-1111-807 000000-1111-808 000000-1111-809	for oil immersion applications $n_D = 1.515$
Cleaning paper, 300 sheets	462975-0000-000	to clean optical surfaces
G-fuse inserts (5x20 mm); T 1 A/H 250 V 2x	000000-0149-685	protects the integrated power unit from excessive load
Dust cover M Dust cover G (only in combination with binocular phototube)	459311-0000-000 459312-0000-000	to cover the instrument after use

4.5 Requesting service

All repairs of mechanical, optical or electronic components inside the instrument and of the electrical components of the Axioskop 40 / Axioskop 40 FL may only be performed by Carl Zeiss service staff or specially **authorized** personnel.

To ensure optimum setting and trouble-free function of your microscope over a longer period of time, we recommend that you enter into a service/maintenance agreement with Carl Zeiss.

For subsequent orders or when service is required, please get in touch with your local Carl Zeiss representative.

Additional information is available on the Internet:

micro@zeiss.de

<http://www.zeiss.de>.

APPENDIX

List of abbreviations.....	A-2
Index.....	A-4
Certification in accordance with DIN ISO 9001 / EN 46001	
EC conformity declaration	

List of abbreviations

AC	Alternating Current
A-Plan	Achromatic objectives featuring improved image flatness (ICS optics line)
Br.	Suitable for eyeglass wearers
CCD	Charge Coupled Device
cod.	Coded
CSA	Canadian Standards Association
D	Cover slip thickness
D	Dark field
d	Diameter (e.g. of filters)
d	Height value (height measurement)
d'	Difference of stage height setting (focus difference in height measurement)
DC	Direct Current
DIC	Differential Interference Contrast
DIN	Deutsches Institut für Normung (German Standards Institute)
DL	Transmitted light
DX	Coding system for the storage of electronically legible information (e.g. film speed)
EG	European Community
EN	European standards
EMV	Electromagnetic compatibility
ENG	Electronic News Gathering
ERGO	Ergonomic
EWG	European Economic Community
FAA	Free working distance
FL	Fluorescence
foc.	Focusing
fot	Photographic
H	Bright field
HAL	Halogen lamp
HBO	Mercury vapor short-arc lamp for fluorescence

ICS	Infinity Color-Corrected System
IEC	International Electrical Engineering Commission
IP	International Protection (protection class)
ISO	International Organization for Standardization
L	Measuring distance (length measurement)
LED	Light Emitting Diode
MC	Microscope Camera
MOT / mot.	Motorized
n_M	Refractive index of the medium
n_D	Refractive index of D-line (sodium)
n_P	Refractive index of the specimen
Ph	Phase contrast
PL	Flat field
R	Right (drive knob to the right of the mechanical stage)
SLR	Single Lens Reflex
SW	Wrench opening
T	Slow-blow (fuse type)
TV	Television
T2-Adapter	Standardized connector for 35 mm cameras
UL	Underwriter Laboratories
UV	Ultraviolet
VDE	Verband Deutscher Elektrotechniker (Association of German Electricians)
vis	Visual
V_{obj}	Magnification of the objective
W 0,8"	Whitworth-type thread 0.8"
W-PL	Wide-angle eyepiece
XBO	Xenon short-arc lamp

Index

Page

A

Adapter	3-40
Adjustment guide	2-15, 3-11, 3-12
Ambient conditions	1-13
Ametropia	2-6
Analyzer	3-30
Analyzer module	3-14, 3-30
Analyzer slider	3-30
Aperture diaphragm	3-7, 3-12, 3-13, 3-22, 3-35
Application	1-2

B

Beam splitter	2-38
Binocular tubes	2-5, 3-5, 3-11
Birefringence	3-30
Brightfield	3-13, 3-21, 3-27
Burner	2-26

C

Centering screws for condenser	3-5, 3-11
Changing fuses	4-3
Color temperature 3200 K	3-5, 3-6, 3-11, 3-12
Condenser	2-10, 2-19, 2-21, 3-5, 3-6, 3-7, 3-11, 3-13, 3-26
Condenser carrier	2-7, 2-18, 3-23
Condenser height adjustment	3-5, 3-9, 3-11, 3-15
Connector plate	2-34
Consumables	4-8
Control display	3-5, 3-12
Conversions	2-19
Conversion filter	3-38
Co-observation equipment	2-40, 3-47

D

Dark field	3-27
Diaphragm	2-20
Digital compact cameras	3-42
Dimensions	1-13
Documentation	3-36
Drawing device	3-51

E

Epi-fluorescence	1-2, 3-36
Ergo-drive	2-31
Ergonomic binocular phototube	3-17
Ergo-tube	3-11, 3-16
Eyecups	2-7
Eyepieces	1-10, 2-5, 2-6, 3-5, 3-11
Eyepiece reticle	2-6

F

Filter	3-5, 3-6, 3-7, 3-11, 3-13, 3-18, 3-36
Filter mount	2-21, 3-18, 3-25
Filter set	2-36, 2-37
Filter slider	3-12, 3-34
Fine adjustment	3-5, 3-11
Fine drive	3-5, 3-12
Fluorescence	3-34
FL P&C reflector module	2-35, 2-36
Focusing drive	3-5, 3-9, 3-11, 3-12, 3-15, 3-23
Focusing drive stop	3-5, 3-9, 3-11, 3-15
Front lens	1-3, 2-7, 2-15, 3-8, 3-12, 3-24, 3-26
Front optics	2-10, 2-19

H

Halogen lamp	2-12
HBO 50 fluorescence illuminator	2-17
HBO 103 illuminator	2-13
Height stop on condenser carrier	3-23

I

Illumination and contrasting procedures	3-21
Incident light	3-11, 3-12, 3-14, 3-19, 3-34
Incident-light aperture diaphragm	3-11
Incident-light filter stop carrier	3-19
Incident-light fluorescence	1-2, 3-34
Incident-light illuminator	3-35
Incident-light luminous-field diaphragm	3-11
Intermediate tube	2-42, 2-44
Intermediate tube for image projection, adjustable	3-51
Installation	2-4
Instrument care	4-2
Instrument description	1-2
Instrument maintenance	4-3
Interpupillary distance	2-7

K

KÖHLER	3-9, 3-15, 3-21
--------------	-----------------

L

Light intensity 3-5, 3-11, 3-12
Light sources 1-14
Line voltage 1-13, 1-14
Line connection 2-11
Luminous-field diaphragm 3-5, 3-7, 3-11, 3-15, 3-22, 3-25, 3-35

M

Maintenance 4-3
Measurement of lengths 3-52
Mechanical stage 2-28, 2-29, 2-32, 3-5, 3-6, 3-8, 3-11, 3-12, 3-14
Mercury vapor short-arc illuminator 3-35
Mercury vapor short-arc lamp 2-23
Microscope camera 3-38
Multi-observation equipment 2-42, 3-47, 3-49

N

Nosepiece 2-8, 3-5, 3-8, 3-11, 3-14, 3-22

O

Objectives 1-8, 2-8, 2-30
Oblique illumination 3-29
On / off switch 3-5, 3-11, 3-12
Operating the instrument 1-13
Operation and function controls 3-4, 3-10
Overview equipment 2-22, 3-18

P

Performing checks 4-3
Phase contrast 3-24
Phase stop 2-20
Photomicrography 3-36
Phototube 3-36, 3-37, 3-47
Polarization 3-30
Polarizer 2-21, 3-30
Push&Click module 2-34

R

Refill set for specimen marker 2-9
Reflector module 3-14
Reflector turret 3-11, 3-14
Requesting service 4-9
Reticules 1-11
Rough drive 3-5, 3-12
Rough adjustment 3-5, 3-11

S

Spares	4-8
Specimen holder	2-32, 3-5, 3-8, 3-11, 3-14
Specimen marker	2-9, 3-9, 3-14
Stage carrier	2-10, 2-19, 2-29, 2-30
Stage focusing	3-9, 3-15
Stage micrometer	1-11
Start-up	2-1, 2-4
Stop carrier	2-20
Switching off	3-20
Switching on	3-20
Switch-on / switch-off	2-11
System overview	1-4

T

Technical data	1-13
Tools	4-8
Torque setting	2-28, 2-31
Transformer	2-11
Transmitted light	3-14, 3-21, 3-24, 3-26, 3-27, 3-29, 3-30
Transmitted-light filter magazine	3-19
Travel distance	2-28, 2-31
Travel distance adjustment	3-6, 3-13
Troubleshooting	4-4
Tube	2-5, 2-33, 2-34, 2-40, 2-42, 2-44, 3-5

U

Universal condenser	3-13, 3-21, 3-27
Unpacking	2-4

V

VAREL contrast	3-26
Vibration direction	3-31
Video microscopy	3-40
Viewing height	2-7

W

Weight	1-13
White-balance filter	2-21

APPENDIX

Carl Zeiss

Axioskop 40
Axioskop 40 FL
